73 Amateur Radio Today

JANUARY 1995
ISSUE # 412
USA $2.95
CANADA $3.95
A WGI Publication
International Edition

Hot Home-Brewing

Build A "Tripole"
Easy PTT Control
Cheap Surplus Receivers
Pyramid-Power Antenna

73 Reviews

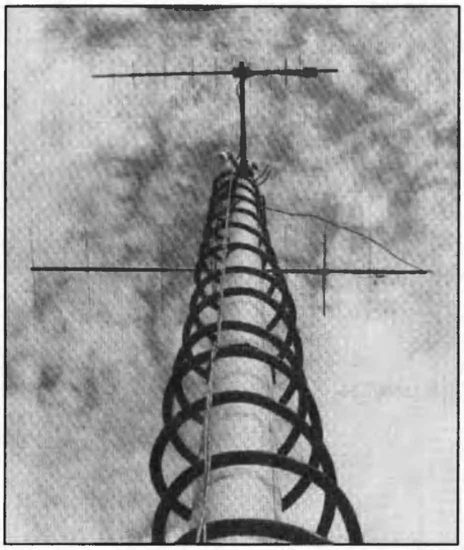
MFJ Vertical
Heil Headsets
Yaesu FT-840

73 Amateur Radio Today

January 1995
Issue #412

TABLE OF CONTENTS

FEATURES



Here's a sky-view of an antenna setup at the recent AMSAT Symposium in Orlando. See "Hamsats" on page 42. (Photo by K1MON.)

REVIEWS

DEPARTMENTS

FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73.*

On the cover: Here is Bruce Lamb VE7IUQ operating ATV mobile on the Sonoran Desert. A one-year subscription/extension goes to Bruce in the 73 Photo Search.

FB

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents ©1994 by Wayne Green Inc. No part of this publication may be reproduced without written permisson of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: Upon reading this agreement, you have entered into a legally enforceable business arrangement whereby you WILL write a report on your latest ham gear and submit that manuscript for publication in *73.*

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

I Need Your Help

The two things that readers enjoy reading the most In *73* are simple construction projects and new product reviews. Make that three things by adding antennas to the list.

Charlie Warrington says he's got a darned good review crew, but he can still use a couple more hams with good technical backgrounds and who enjoy writing to try out the latest in new equipment and give us reports to publish.

That's fine, but I'm even more interested in what *your* experience as an average ham is when you buy something new. The next time you buy some ham gear be sure to keep notes and send me a report telling me how it did for you. I'd love to try every new piece of equipment that comes out, but you know, when I had the time I didn't have the money. Now that I have the money, I haven't got the time. Phooey.

So I'm depending on you. One of the most fun aspects of hamming is buying something new and putting it on the air. It's a real challenge to put a solid signal on any band. It takes a good receiver, transmitter, amplifier, and antenna. Every antenna I've put up has a story In it. I'll never forget the two twin-three antennas I hung up at my fraternity house when I went back to college after WWII. They were bi-directional beams hung between the house and nearby trees, and they worked out like gangbusters. Wow, did they put out a signal! My signals were heard first and dropped out last due to their particularly low angle of radiation. They were by far the best antennas I've ever used on 20m, including some very expensive big beams.

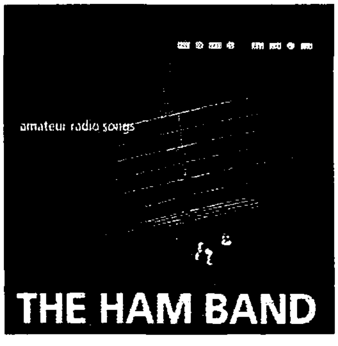
I keep hoping you'll write and tell me what the most exciting thing is that you've done In amateur radio. I've been telling you about mine. Grab your word processor and send me a disk, okay? And don't forget to tell me what you like best about the rig you're using. Don't just sit there mumbling into your D-104, start writing.

Yes, I get a ton of mail. And I read It. No, I don't answer it all, and I don't want any nastygrams about my lack of courtesy In not answering. I write to well-known people all the time and rarely get an answer. Meanwhile I whup out at least a dozen letters a day.

Ho Ho Ho

Yes, kindly Santa, that cheap old codger will be around, nagging you to give presents In his name.Well, It Is the time of year to remind friends that you haven't yet won that coveted *QST* Silent Key Award. You're probably expecting me to suggest you take care of this with 12 monthly reminders of your thoughtfulness, namely a gift subscription to *73*, right? Hmm, if I'd thought about it, that would have been my recommendation. I'd have mentioned that I have a choice for you, the el cheapo gift subscription, which is $19.95, or the deluxe gift subscription, which is $24.95. Your choice. They get the same magazine either way. This is just a test of how cheap you are. If you've read any of my travel booklets you know how thrifty I am. Thrifty, not cheap.

There's another gift you might consider lor your ham friends. This is the first compact disc of ham music. Ham



music? The songs were written and sung by Andrew Huddleston and Lissa Ladefoged, OZ1ADL and OZ1XY, and they're good. Darned good! There's one on DXpeditions, another on Morse code, and the XYL's lament that he's "Always on the air." Andy says, "I'm not climbing up the tower any more!" There's one about "The Trip to Dayton," where Andrew and Lissa spent their honeymoon at the HamVentlon. And I loved "Rotuma Bound," another DXpedition song. The music varies from country to soft rock and it's great stuff. Give yourself one of these for Christmas, and then get some for friends. Ham friends, of course. But then, what else have you?

The CD title is "Seek You." They wanted to call it "CQ" but *CQ* magazine threatened to sue them, so they had to change it at the last minute. I wish they'd called it "73." Maybe their next CD will go that route. The disc is by Last Resort Records. You'll be able to buy it direct from Last Resort, or from Uncle Wayne's Bookshelf.

Now, let's get the CD and start sending the digital information on the CD over the air. Yes, it's legal to send music over the air . . . if you do it digitally.

Cold Fusion Update

The researchers in the field are making progress, but no one has yet made a stand-alone cold fusion power generator. My *"Cold Fusion"* magazine got off to a good start with a 100-page first issue, packed with Information. The next two issues looked nice, but were short on real information. Frankly, I was disappointed in them contentwise. The third issue, while dreadfully short of new material, won the 1994 Ozzie for the best designed new technical magazine.

Between the weak second and third Issues, plus a 90% shortfall on expected advertising and subscription revenues, I decided to to be practical and retrench to a less expensive newsletter format until the field starts to grow. This triggered the termination ol my science-writer editor. However, a recent front-page article in *The Wall Street Journal* on the reality of cold fusion may help. As the new editor, I'm up to here in mu-mesons and various cold fusion theories. I've got a crackerjack technical support team, which will help make up for my physicist weakness.

I really didn't need this aggravation at the same time as another financial crisis, but I'll have an interesting blow-by-blow story for you one of these days. I've sure found out who the people are who can be trusted when things get tough and who are ready to take every possible advantage.

The first newsletter format (which ran 32 pages) only triggered two requests for subscription refunds. Most of the mail was congratulatory on the improvement in material, plus the end of the previous editor's absorption with ridiculing the cold fusion foes and with articles about how wonderful the world powered by cold fusion is going to be. A little of that stuff goes a long way. Now we're concentrating on trying to figure out why researchers are getting all that anomalous power. If you're into physics or electro-chemistry, you'll enjoy the publication. But you'd better bone up on your quantum mechanics.

The 5th issue is a corker and more good material is coming in regularly, just as I expected. The original subscription price was $98 a year. I offered a special charter rate of $58 for the first four issues, but now it's back up to $98. For anyone interested in research every issue is worth more than that. If any *73* readers are interested, I'll continue the $58 subscription rate for you. Just menion Wayne's special offer.

There are two other newsletters In the cold fusion field, *Cold Fusion Facts,* which is quarterly, $46 a copy (12 pages) and $120 a year, and *Fusion Facts,* monthly, $30 a copy (24 pages) and $300 a year. At $98 per year and $10 a copy (32 pages for #4), *"Cold Fusion"* is a bargain.

A Quote from *Forbes*

In a *Forbes* column by Peter Huber last year he discussed the effect technology is having *on us. For* instance, when I was young we spent a lot of time in school on penmanship. Well, handwriting was how one communicated then. Typewriters were too expensive for most homes and typing wasn't taught in school. Once typewriters were cheaper, the need for good penmanship disappeared. So did good penmanship.

Spelling was a big deal when I went to school. Now it's handled by my word processor, which catches my errors. Peter suggested that before long making kids memorize all the Irregular spelling rules will be like making radio engineers learn the Morse code. Heh.

We'll soon have automatic language translation, and computers with voice input. Look where we are with bar-code and checkout counters which add up the items, calculate the change due, debit the store inventory, and presumably even automatically add in a few cents here and there to pad your bill and improve the store's profits. Fast-food cash registers have pictures now instead of numbers, which is handy since fewer and fewer kids are being taught how to make change, and many are reading-challenged.

There used to be a good reason for memorizing the multiplication tables. Now, with calculators cheaply available, that's almost as antiquated a need as learning the code.

If you're into video you can have a complete video production lab at home and do what used to take millions of dollars in equipment all by yourself. In audio, DAT recorders are under $1,000 and outperform a whole studio full of gear from a few years ago. Gas stations let you pump your own and pay with a credit card, with no attendant

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Michael Farrar VE3WMF, Richmond Hill, Ontario, Canada Dennis D. Powers ("Letters," November 1994) and many others make the statement that the CW requirement somehow weeds out those who have not "demonstrated some commitment to both themselves and the hobby." Supposedly, this commitment through the knowledge of CW will maintain its high standards.

If this is the case, then Mr. Powers would explain to us why the HF bands are rampant with aggressive, ill-mannered and abusive behavior. Where we have interminable racist, sexist tirades by redneck ya-hoos who, no doubt, have mastered CW at the highest required speed, but have not mastered the requirement to ID at the end of each transmission or every 30 minutes. Standards? What standards? I'm a No-Code Tech (VE variety), and I think I have a very strong commitment to the hobby. I do not want to see it die or, in fact, commit suicide, which is what it is doing by clinging to CW.

The CW requirement is going to be the death of the hobby. As long as we are perceived as a bunch of "old geezers" we are going to continue to lose spectrum, and as long as we keep CW as a requirement, then we remain "old geezers." Eventually we might end up with only the 30 meter band (it is a CW band, so all will not be lost.)

Tom Ewing VR2GO/WH6GC, Hong Kong To whom it may concern: I was shopping for simplex repeaters over the last few days, when I called a North American distributor for information and availability on a particular unit. When this vendor asked where I was calling from, I told him Hong Kong, which brought laughter and disbelief from the vendor. "It's impossible . . . I can't hear the delay in the phone line." Well, sir, you were wrong, and by basically calling me a liar you have succeeded in losing a sale.

Vendors, please wake up and utilize some basic PR skills.

Ronald T. Cyre KE4QWP, Jacksonville FL Wayne, I believe we have seen the end of the free licenses for ham radio operators. The reason: money. There are only 400,000 hams. If they charged $10, the FCC would have 4 million more dollars than they have today. Licenses would be renewed every five years, not 10.

I am not opposed to the fee, if we get something for it. I figure we are going to lose more frequencies and parts of bands, and have more band sharing as the FCC gets money-hungry. Do not depend on our friends (fellow hams) in the FCC; they all have bosses who want to keep their jobs and their fiefdom of employees.

I believe that in this day and time the fee is justified. I would hope that you would see the value of a fee. But negotiate something for it; world frequencies will be changing. Our future is not in HF, but in UHF and above. I hope the CW guys can see the future. We need CW and do not want to lose it, but they are chipping away at our UHF and GHz areas. (From a new ham.)

Ron, the government doesn't work that way. You haven't been reading my editorials! Tsk. When the FCC levies license fees the money goes directly into the Treasury, not to the FCC. And every time there is a new source of money into the Treasury, Congress salivates and bargains among themselves as to who will get it for their local pork projects, with the old-timers being first on the pork list. The FCC won't even get a smell of the bacon or a taste of a pig's knuckle. The only way I can see for amateurs to "pay their dues" these days is to recruit a million or two young hams. This will (a) give us a stronger voice when Congress decides to sell off more frequencies, and (b) will generate enough high-tech career scientists, engineers and technicians to pay the rent . . . Wayne

Jim Kornacki KD4WYS, Jackson SC Wayne, let me introduce myself. I was born in Connecticut and raised by Mom W1UBM and Dad W1YOC. I still have both original parents (a rarity today). I moved to South Carolina in 1990 when I left the Navy after 10 years for a real life. Up until this time I had absolutely no interest in radio at all. Then one day I began to feel a little guilty about not having carried on the family tradition of wireless. A week later, thanks to the miracle of the No-Code Technician license, I did the folks proud. Then a really strange thing happened: I started to get into this radio stuff!

To make a long story short, I'm having a blast with the new-found hobby. I consider myself a Plus in the ham community, always wanting to try new things, and doing my best to tolerate the Minuses. In the past 18 months I've worked all states on 10 meters, upgraded to Advanced Class, worked stations via satellite, racked up a lot of DX, participated in contests, served on the Board of Directors of the local club, coordinated this year's Field Day effort, and volunteered my time to various community service events.

I've recently decided to try my hand at QRP operating. Why? Because it's something new, it's challenging, and it will get me away from all the Minuses who have staked out their territory on the SSB portions of the HF bands. I received a nice welcome to the 75 meter phone band when I tried to say "hi" on the local shoot-the-breeze frequency and all I got in reply was a "K4" making fun of my callsign. I've since done a lot of listening and it seems that "he who holds himself in the highest esteem" on the air is usually the biggest jerk who contributes nothing to the hobby. On the flip side, you couldn't find a better bunch of folks than those operating in the Novice portion of 10 meters. Anyway, imagine my joy at seeing the October issue dedicated to QRP. Good timing!

By the way, I read all three ham magazines because I like to know what's going on. They're all pretty good, and each has its strong points. I like your editorials ("Whadaya Read?" had me laughing out loud), and the article on building the simple 10 meter QRP rig was cool.

I'd like more help on building stuff because I'm not much of a builder. Seems like every time a hammy mag offers a simple project to the ignorant non-builder it's an antenna or some stupid gadget I would never use. Useful things, like radios, are fairly complicated and presented all at once. This tends to overwhelm and discourage me. Maybe you can take a "simple" rig and present it in smaller, easier-to-handle parts, with some explanation as to why this thing needs to be done instead of just "what to do." I remember hearing about a book that was written like that, where you built different components and they would all work together later on. There seems to be a giant gray area between learning all the electronic theory associated with radio and actually applying it.

Red Costlow W7GXR, Scottsdale AZ Wayne, I really enjoy *73*, mainly for the construction articles. Though my eyes are weak and my hands not that steady, it still makes me salivate to see the neat articles. I also enjoy your column. I don't always agree, but you sure do stimulate the gray matter.

I have been a ham since 1948 as WØQQM in Minneapolis, W8DNR in Dayton, and my present call here. I am retired and live in an apartment. The manager here is a ham and is letting me put up my R7. I am also laying a Delta Loop from *73* on the flat roof. I may have to go to QRP as some of the tenants here do not have cable and I know that I will probably get into some sets. I have a Heath SB 1400, an Alinco DR 110, and an MFJ-1278 TNC. I am still very green on the digital stuff. My computer is a 486 made up of scrounged boards and parts.

My pet peeve is the heavy emphasis on contesting. I have no argument on contests, as I used to be into that. What I do object to is that just about every weekend there is one that runs for the entire weekend. With the equipment we have today, automatic ID, etc., and scores of a billion, something is wrong. I would like to see some restrictions. Why not force all stations to operate QRP and find out what real contesting is all about? I know I am wasting my breath. I just want to get on and chew the fat. No, not about my rigs, etc., but about what my contact does, hobbies, books, music, photography, and on and on.

Keep up the good work and keep raising hell!

Russ Streeper WA4BWB, Lynchburg VA I have never written before but just had to drop you a note to tell you how much I enjoy *73* these days. I have been an on-again, off-again subscriber over the years, totally dropping out when your involvement declined, only to subscribe again a couple of years ago. I had been purchasing your magazine at the newsstand and realized that all of the good antenna projects and most of the useful information I was gathering about the hobby was coming out of *your* magazine. I therefore promptly subscribed with one of your multi-year incentive plans.

The thing that squeezed the trigger and made me write was your editorial in the October issue. As much as anything, I get your magazine for the access to the thought-provoking experience and perspective that you have developed over the years. Portions of your editorials have been used to advise my children and inspire my wife. The October issue is in a class by itself, however.

I don't think there is another editor in America who covers as much ground (recipes to ICs) as you in a fashion that is a joy to read and think about. Thanks for being much more than a "ham."

For my part (along with the other boys in our commercial radio shop), you do a great job of keeping us current on technical stuff, too. "Carr's Corner" is well-read here for the "street-wise" applications of the latest micro goodies. His columns, like *73* itself, show us how to put things into action.

Let me propose a thought: Ham radio is a valuable resource for children. My kids have packet friends in England and exchange messages and all kinds of information about our two cultures, governments, etc., as a direct result of my involvement in ham radio. It takes a willing ham at the other end of the mike (or key), but the effort can have a big payoff. I have had a few hams from other parts of the world stay in our house. It has been an enriching experience for all of my family. Kids learn about the reality of life in other parts of the world. You can't buy experience like that they get this way! It helps them in school in ways you wouldn't imagine. This type of ham experience lasts much longer than the joy of a new QSL card, in my opinion. Human experience is a valuable thing. Kids, as part of a ham family, have direct contact to this resource worldwide. This has been a great selling point in getting a SAREX program going with the local school system, in conjunction with Lynchburg Amateur Radio Club.

Wayne, you should get an "at-a-boy" award of some type for stimulating our interests. Really, people do read and enjoy your magazine. Some, like me, don't care for the politics of a hobby, but there is a lot to consider between the pages of *73*. Keep up the good work for a very long time. We'll be happily reading the results.

Phase 3-D Project On Schedule

Members of AMSAT's Phase 3-D International Satellite Design Team met in Marburg, Germany, in mid-October for a "top-to-bottom" review of progress on ham radio's most advanced satellite. Dr. Karl Meinzer DJ5KQ and Werner Haas DJ5KQ hosted a series of detailed meetings on all systems and subsystems. During these discussions, team members bench-tested a number of flight hardware electronic items, and set the final operating frequencies for the spacrcraft's transmitters and receivers.

"It was a marathon session," said AMSAT's Dick Jansson WD4FAB upon returning to the US. Team members are now very confident that all key elements of the project are on schedule and that the spacecraft's integration in Florida can continue without interruption.

Phase 3-D is slated for launch in 1996. The sophisticated bird will weigh nearly 900 pounds at launch and, after reaching orbit, will unfurl a solar-panel wingspan of nearly 20 feet.

W2SKE Dead at 78

Bill Leonard W2SKE, a former president of CBS News, died at his Laurel Maryland home on October 23, at age 78. Leonard was an avid DXer and contester in the '60s and '70s and became a well-known spokesman for amateur radio. As President of CBS News, Leonard was credited with the selection of Dan Rather as Evening News anchor, as a member of the team that developed 60 Minutes, and for development of techniques

Photo A. QCWA Hall of Famer Leo Meyerson WØGFQ at the Western Heritage Museum in Omaha, NB. (Photo by Jim Musgrove K5BZH.)

which help to predict the outcomes of elections.

During a 1981 interview, Leonard predicted that computers would become more a part of ham radio. He added, "My bet is that ham radio, in one form or another, will be around 100 years from now." *TNX Mohawk Amateur Radio Club, Inc. M.A.R.C. News, November, 1994; ARRL.*

Broadcast FAX

According to Electronic Engineering Times, NBC has formed a data network to broadcast information over the air in the VBI (vertical blanking interval) portion of the network's television-broadcast signal. The first commercial offering will be a facsimile service in cooperation with a London-based firm.

The encrypted addressable FAX will send to specially-equipped computers and FAX machines. One purpose will be to send company information to employees who work at their own homes. Similar technology has been used for years to deliver closed captioning data in the VBI. *TNX Electronic Engineering Times, November 14, 1994.*

WØGFQ in QCWA Hall of Fame

Leo Intone Meyerson WØGFQ was inducted into the Quarter Century Wireless Association's Hall of Fame at the 1994 National Convention. Meyerson has been an avid operator and promoter of ham radio since he received his first license in 1928.

Meyerson founded several amateur radio related companies, including Wholesale Radio Laboratories in 1935, and Galaxy Electronics in 1962. Active in public service, Meyerson has also been a key figure in disaster relief efforts. *TNX Jim Musgrove K5BZH.*

New Paging Licenses

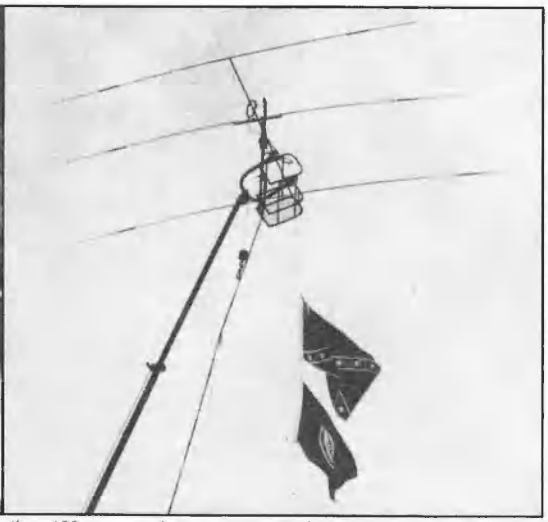
According to an article in Electronic Engineering Times, The Federal Communications Commission's auction of 30 regional licenses for advanced paging services has been completed, with bids totaling some $489 million. The government expects to net $394 million.

Six licenses were issues in each of five regions from the narrowband wireless auctions. Each region will soon have two licensees ready to deliver two-way voice-quality communications and four others equipped for two-way paging. *TNX Electronic Engineering Times, November 14, 1994.*

FCC To Expand AM Band

The Federal Communications Commission is in the process of expanding the AM broadcast band to incorporate spectrum between 1605 and 1705 KHz. The commission has determined that by expanding the AM band, interference would be reduced and overall quality would improve in the existing 535 to 1605 KHz band.

Eighty AM stations have been identified as being qualified to apply to migrate to one of the 10 new frequencies. Travelers' information stations broadcasting traffic and road conditions at 1610 KHz would remain protected. *TNX W5YI Report, November 1, 1994.*



Photos B & C. Thirteen-year-old Ben Vlug AD4UR logged more than 100 contacts during a recent Civil War reenactment in Roanoke County, Virginia. The Extra Class ham is a member of the Roanoke Valley Amateur Radio Club, sponsor of this special events station. A 24-thousand-pound Kinsey sign crane lumbered into Green Hill Park to set-up this tribander beam some 75 feet in the air. The Battle of Hunter's Raid was revisited, while 43 states and more than 500 contacts were made. TNX Mark Green KE4FPL.

Number 4 on your Feedback card

73 Review

by Arnie Johnson N1BAC

Yaesu U.S.A.
17210 Edwards Rd.
Cerritos CA 90701
Telephone: (310) 404-2700
Price Class: $1,099

The Yaesu FT-840 HF Transceiver

Enjoy a simple-to-operate full-featured HF rig.

As we all probably know by now, there are hams who want all the push-buttons, lights, and knobs they can get, and there are those who are intimidated by all those controls and lights. For those of you who are among the intimidated, I've found a great rig for you. I had a chance to play with a radio that is very straightforward and easy to use, and offers nine bands and a general coverage receiver: the Yaesu FT-840 HF transceiver.

Now, don't get me wrong—just because a radio doesn't have a bunch of buttons to insert the frequency and bands doesn't mean that it isn't capable of frequency memorization and interfacing with a computer. This radio performs a lot of great functions.

The package as it came to me consisted of three boxes; the FT-840 HF transceiver, the optional FP-800 power supply/speaker, and the FC-10 automatic antenna tuner. All were well-packaged, and the contents were well-protected. Hooking everything up was very straightforward.

The Front Panel

I was very happy to see that the FT-840 is a somewhat small radio, approximately 4" (H) x 9-1/4" (W) x 12" (D), counting connectors, and very easy to put in your car without asking your wife or friends to sit in the back seat while you put the radio in the front. The front of the radio is not very imposing, just straightforward: 28 well-labeled buttons, seven knobs, frequency/mode read-out, an S/PO/ALC meter, mike connector and 'phones jack. The first group of buttons on the left side of the panel control power, meter choice (PO or ALC), MOX (manual transmitter activation), attenuation, mike processor, AGC, noise blanker, SSB, CW, AM, FM, and frequency lock. Others on the right side control functions of the A & B VFOs and memories, split, tuning speed, choice of ham/general receive, and changing of bands. The last button group manages the automatic antenna tuner (if used), memory choice, scanning, and clarifier on/off.

Centered under the large, well-lit and easy-to-read frequency/mode read-out is the main tuning knob which has a very nice touch of movement. Knobs on the left are inner/outer knobs for microphone input level for SSB & AM transmission and RF power output in all modes. The other inner/outer knob set is AF, which adjusts the volume of the receiver, and Squelch, which sets the signal threshold at which the receiver audio is muted in all modes. The last two knobs, on the right, control the Clarifier offset frequency up to +/- 1.25 kHz, or optional 2.5 kHz, and the IF passband center frequency from the displayed frequency in modes other than AM and FM.

All the controls are well-labeled and easy to see. The large read-out shows the receive/transmit frequency, modes, memory channel used and whether you have tuned off that frequency, antenna tuner operation and high SWR, clarifier use, scanning selected, FM +/- offset and CTCSS tone use, frequency lock in use, fast tuning, VFO choice, general coverage receiver in use, split frequency selected, squelch open, and transmitter in operation.

The Back Panel

But there's more to a radio than just the front panel. The radio can't do much for you unless the signal can make it out to the antenna. Turning the radio around to hook up the antenna provides a view of the some of the rest of the controls/connections that continue to make this radio what it is.

There are only three set-and-forget controls on the back: speech processor compression, CW semi-break-in timing control, and CW sidetone level. Also on the back are connectors for antenna coax, the power connector, 200mA/13.5 VDC output, CW keyer, constant-level receiver audio output for use with a packet TNC or other terminal unit, external ALC, external Push-To-Talk, external speaker, a 6-pin mini DIN input/output jack for external computer control, a 5-pin mini DIN jack for the FC-800 external automatic antenna tuner, a 8-pin mini DIN jack for the FC-10 external automatic antenna tuner, and an 8-pin jack to output control signals for the FL-7000 linear or FC-1000 ATU.

One more feature that needs to be mentioned is the grill on the back, which hides the internal thermally-switched fan that allows full transmitter output without any rear panel protrusions.

Hookup

Hookup is very straightforward. The MH-1 B8 hand-held microphone, providing up/down frequency changes and speed of changes, connects easily to the front panel. The frequency change buttons on the mike can also be used to start and stop receiver scanning. The radio comes with a double-fused DC cable and plug to hook to your own 13.5-V DC power supply or automobile electrical system, but I used the provided FP-800 power supply/speaker.

Lastly, I hooked up the FC-10 Full Automatic Antenna Tuner. Again very easy: Hook your antenna coax to the ANT connector, the coax jumper between the TRANSMITTER

connector and the radio connector, and the controller cable from the CONTROL connector to the 8-pin DIN jack labeled TUNER 2 (for the FC-10 tuner) on the back of the radio. Don't force the connectors—make sure that the pins line up before inserting and that you are inserting the 8-pin male connector into the 8-pin female receptacle, not the 5-pin labeled TUNER 1 (for the FC-800 tuner).

General Description

Yaesu developed the FT-840 to be a high-performance transceiver that provides up to 100 watts transmitter output power on all HF amateur radio bands in CW, SSB, and FM modes, and up to 25 watts carrier in AM. The receiver tunes all frequencies between 100 kHz and 30 MHz in 10-Hz steps.

Modular circuit design employs surface-mount components on composite epoxy boards for high reliability and serviceability. Twin direct-digital synthesizers and a magnetic rotary encoder provide silent, silky-smooth tuning. Frequency accuracy and stability are assured by driving both synthesizers from a single master oscillator, and the optional TCXO-4 temperature-compensated crystal oscillator is available for enhanced +/- 2ppm stability from 0-50° C.

The FT-840 features a low-noise, high-performance receiver front end. Interference rejection is facilitated by the unique "up-down" conversion scheme, and includes an IF shift circuit. The optional YF-112C crystal filter can be installed to provide enhanced CW reception, and an AM-wide filter is also available for greater fidelity during broadcast reception.

A 16-bit microprocessor in the FT-840 is programmed to provide the simplest possible control interface for the operator. Two independent (A/B) VFOs for each band (20 total) hold their own frequencies and mode settings. One-hundred memories store all of this data for both VFOs, giving a total of 220 independent sets of frequency, mode, and other selections. Flexible scanning features allow all 100 memories, or only those selected to be freely-tuned and scanned. Group scanning allows you to organize your memories into 10 groups, and only scan channels within a selected group. In addition, 10 special memories also let you limit the tuning/scanning range between their stored frequencies. Scan resume is selectable between timed or carrier-delay, and scanning speed is also adjustable.

Operation

Well, as it is said, "the proof is in the pudding." How does it play? The tutorial suggests that you check the following switches and knob positions before any hookups: POWER & MOX switches off; MIC, RF PWR, SQL all ccw (minimum); AF 10 o'clock; CLAR off; SHIFT 12 o'clock. After hooking it all up, it is very easy to operate. When using a power supply, Yaesu suggests turning the power supply on first, then the transceiver, to avoid having voltage spikes damage the radio.

Power switch ON, display lights on, no smoke! That always makes me feel good. Normal hiss from the speaker. I started tuning around; nice feel to the tuning knob. Good signals coming from the speaker; nice audio quality.

Specifications

General

Receiving frequency range: 100 kHz-30 MHz
Transmitting frequency ranges: 160-10 meter amateur bands
Frequency stability: +/-10 ppm (or +/- 500 Hz FM), from 0-4°C and +/-2ppm (or +/- 300 Hz FM), from 0-50°C (w/TCXO-4 option)
Emission modes: USB, LSB (J3E), CW (A1A), AM (A3E), FM (F3E)
Frequency tuning steps: 10 Hz/100 Hz (CW, SSB); 100 Hz/1 kHz (AM,FM)
Antenna impedance: 50 ohm nominal
Operating temp. range: -10 - +50°C
Supply voltage: 13.5 VDC +/- 10% negative ground
Power consumption (approx.): 1.2A rx (no signal); 20A tx (100 watts)
Dimensions (WHD): 238 x 93 x 243mm
Weight (approx.): 4.5 kg

Transmitter

Power output: Adjustable up to 100 watts (25 watts AM carrier)
Modulation types: SSB—balanced, filtered carrier; AM—low-level (early stage); FM—variable reactance
Maximum FM deviation: +/- 2.5 kHz
Harmonic radiation: Greater than 50 dB below peak output; 45 dB (10, 18 MHz)
Spurious radiation: Greater than 40 dB below peak output
SSB carrier suppression: Greater than 40 dB below peak output
Undesired sideband suppression: At least 50 dB below peak output at 1.5 kHz modulation
Audio response (SSB): Not more than -6 dB from 400-2600 Hz
3rd-order IMD: -25 dB @ 100 watts PEP, 14.2 MHz
Microphone impedance: 500-600 ohms

Receiver

Circuit type: Dual-conversion superheterodyne
Intermediate frequencies: 1st—47.055 MHz; 2nd—8.215 MHz; 3rd—455 kHz (FM)

Sensitivity:

Freq/Mode	150-250 kHz	250-500 kHz	0.5-1.8 MHz	1.8-30 MHz
SSB,CW (2.4 kHz)	Less than 5 μV	Less than 2 μV	Less than 1 μV	Less than 0.25 μV
AM (6kHz)	Less than 40 μV	Less than 16 μV	Less than 8 μV	Less than 1 μV
FM (28MHz-30MHz)(8kHz)	——	——	——	Less than 0.5 μV

Selectivity:

Modes	Min 6dB BW	Max 60dB BW
CW narrow (optional)	500 Hz	1.8 kHz
SSB, CW, AM narrow	2.2 kHz	5.0 kHz
AM-wide (optional)	6 kHz	14 kHz (-50 dB)
FM (optional)	8 kHz	19 kHz

Squelch sensitivity 1.8-30 MHz (CW, SSB, AM)L Less than 2.0 μV 28-30 MHz (FM) Less than 0.32 μV
IF rejection (1.8-30 MHz) 60 dB or better
Image rejection (1.8-30 MHz) 70 dB or better
IF shift range +/- 1.2 kHz
Clarifier tuning range/steps +/- 1.25 kHz/20 Hz; +/- 2.50 kHz/10 Hz
Maximum audio power output At least 1.5 watts into 4 ohms with less than 10% THD
Audio output impedance 4-8 ohms

One of the first things I decided to do was see how the automatic antenna tuner would work. I selected TUNER and the TUNER logo came on the display panel. Now what? I keyed the mike and saw TX and WAIT (under the TUNER logo). I correctly assumed that this meant that I shouldn't do anything until the tuner did its thing. I assumed that to tune I should hit the button marked START. I glanced at the Operating Manual just to make sure. Yep! I then watched the Power Out indicator fluctuate up and down as the tuner worked and the transmitter dropped out, showing completion. I later inserted a two-needle SWR meter between the transceiver and tuner to watch the show. Quite interesting. After using the tuner once on a band, it recalls previous settings from memory (the tuner has 31 of its own) during reception, whenever you tune to the same part of the band again. It's fun to watch the WAIT light flash on as you tune through a band (only with TUNER selected). It even does a great job on 160 meters which some other manufacturers' tuners do not. I did find that the tuner didn't reach proper tune on some frequencies using my 160 meter dipole, but could reach the tune if I worked my way up or down to the frequency, starting at a point where it would tune. No big deal, just some extra time involved.

I then tuned around and responded to several CQs. The reports of transmitter audio quality were quite good; processor audio just increased the "punch" a bit. While playing with the hand-microphone, I noticed a switch on the back labeled TONE - 1 or 2. Changing the selection changed the tonal quality of my voice. Setting 2 suppressed the low frequencies in my voice. I left it in a position (1) that reports said was best for my voice. I also played with the DWN and UP scan buttons on the mike, and checked how FST affected the scan rate.

Next chore, make some memories. Is it easy or do I have to read the manual? Select an unused memory channel with the MEM DOWN/UP buttons, select your frequency, press the VFO>M button for 1/2 second (hear 2 beeps), and it's done! Is that easy or what?

I must also say something about the well-written Operating Manual. From what I can see, it has left nothing out and is not too technical. One thing that I really liked was at the start of the Operation Section. It began with a tutorial: step-by-step samples of what you can do to get started and become familiar with the equipment.

The rest of the time operating with the FT-840 was spent playing with all the knobs and buttons. No surprises! It made many contacts during its time with me and never caused any problems. I'm going to hate giving this one back! A rig like this could keep me happy for many years to come.

If you are looking for a small, quality, well-featured, all-band HF transceiver that is easy to operate, the Yaesu FT-840 HF transceiver could be a good choice for you. ■

Optional Accessories

- Two external automatic antenna tuners: the FC-10, styled to match the size and appearance of the FT-840 in the shack; and the FC-800, which can be mounted outside at the antenna feedpoint or in the trunk of your car;
- The FP-800 AC power supply with loudspeaker;
- The SP-6 external loudspeaker with audio filters and the optional LL-5 phone patch;
- The MMB-20 mobile mounting bracket;
- The YH-77ST headset;
- The FM unit—747 narrowband FM reception and transmission;
- The FIF-232 CAT system interface to convert the TTL levels required by the transceiver to the RS-232C levels required by the serial port of a computer;
- The MD-1C8 desktop and MH-1B8 hand microphone;
- IF crystal filters for CW and improved AM reception.

The Pyramid Antenna

Harness the power of this 10 meter workhorse.

by Dave Brown W9CGI

Do you believe in "pyramid power"? I do. But not the kind where you have to sit under a pyramid, or put things under it. In fact, I would not even recommend that in this case, as the effects of RFI on the human brain are just beginning to be understood. It is best and safest, therefore, to *not* sit under or to close to *any* antenna. The pyramid I am about to tell you about grew out of my continuing experiments with all types of antennas.

I became a ham originally because I found antennas, and that invisible link or transfer of power from a physical object to thin air, absolutely fascinating. I think you will find this antenna, the "Pyramid," interesting in construction and concept, easy to build, and quite rugged. That last part always has been interesting to me, as when I do build a winner from a performance basis I hate to be repairing it all the time—instead of *using* it on the air! This one, like a bridge, has inherent structural ruggedness.

Why a Pyramid?

That's a fair question, considering I have never seen anything that looks quite like my antenna. The design sort of evolved from trying to get an idea from paper to the sky. That is true of many antennas I have used over the years, and I'll own up to the fact I am not an antenna engineer by trade. I get antennas that work, and work well thank you very much, quite like Edison got inventions. I derive concepts from others' ideas and articles to be sure, and often times an antenna like this one truly is revolution by evolution. I started off by wanting to try the extended ideas of the bi-square, or extended dipole. This is nothing more than a regular dipole with an extra 1/2 wavelength added to the driven side of it. I learned years ago when I first used it that PVC tubing is the way to go whenever possible to do the "plumbing" (forgive the pun) on any of my antenna projects. It is strong, easy to cut, and many of the joiners you require for a particular configuration already exist as the 45 degree ELL, the 90 degree elbow, and of course the TEE. The mechanical construction of the Pyramid is nothing more than the proper collection of these with the correct lengths of 1/2" PVC tubing. A word of warning to those of you who do not do any amateur home plumbing or repairs: All plumbing items and pipe refer to flow, and therefore to *inside* diameters. Electrical conduit, on the other hand, is measured by *outside* diameter. This can be a great convenience when intermixing the two for antenna projects, but can be quite confusing to someone trying all this for the first time. The 1/2" tubing used to build the Pyramid is actually nearer to 7/8" *outside* diameter.

When you are trying to visualize my antenna, I'm sure that it might help you see something just a bit bigger, and stronger, than the 1/2" implies. To further explain why this Pyramid, like all Pyramids, is a joining of several triangles along their sides: It has long been known in the structural trades that the triangle is the *strongest* natural shape known to man. Thus, when you unite several of them, as in the side rails of older bridges you still see, you end up with a very strong truss or support.

There was one caveat I learned after the first attempt to build a 10 meter version of the Pyramid: The heat of summer *does* cause PVC, a plastic, to sag somewhat. Not wanting to find out the hard way how far the sag would go before breakage would result, I built the first version of the 10 meter Pyramid with a few more webs for the spiders to walk on and the birds to try to avoid. On the backside, as you will see, this also led to a very convenient place to run a nice centered feed down to the reflector element and keep the electrical construction well balanced side-to-side. The use of tubing at the corners nicely takes care of a place to run the feed for the driven element as well. Consider if I had merely run the feed down the center tubing at the front, and done the reflector "feed" down the center back to a normal reflector element—voilà—a standard 2 element yagi beam. Admittedly it would look different, but that is all it would be.

Bend Here—Tuck There

Bending the driven element as I did into the Pyramid was for two reasons. The first was the simple fact that if you do not do so, even on 10 meters, you would wind up with the bi-square about 33 feet long. That puts you out of the VHF "plumbing" league, and right back to unwieldy and usually unsteerable wire antennas. My Pyramid had to "steer" like a yagi, but beat it in performance. After all, it was my newfound and totally accidental love for QRP on 10 meters that led to the Pyramid in the first place. "Folding in" the ends of the bi-square allows the width to become about 16-1/2 feet, and back to what I consider manageable yagi-type antenna sizes. The electrical reason to bend the ends in did not come to mind until I began a rather vigorous evaluation of the antenna against my usual 10 meter antenna (a three-element home-brew yagi), and a reference dipole also made up into PVC for strength and weathering. Just as any other time you bend/fold an antenna element, both the feed impedance and the pattern of radiation arc going to change. When you start bending things around in an intentional manner as I did, you can only hope the other changes are going to be ones that are favorable. I'm happy to report these certainly were very favorable. Bending cut the apparent beamwidth by about half as compared to the bi-square out straight, and to about a third as compared to my dipole! Now that does *not* make it like the razor-sharp VHF/UHF antennas I have built, but it sure puts a lot of gain in the direction you want it to go. It makes an ideal contest antenna for me, as the apparent beamwidth of about 20 to 25 degrees at the major lobe, and no nasty minor lobes, lets me put everything "on-target," and still not be so narrow as to miss half the fun going on. This 5-watt fetish I seem to have caught only since getting the use of 10 meters (I was a 30-year Tech licensee, with absolutely no interest in the other HF nonsense and quibbling), and needing an antenna like the Pyramid to make up mostly for the other guy's killer-watts. On a quiet band devoid of the horsepower hogs, I managed even before the Pyramid to get my WAC in a month, the 1,000 mile-per-watt club in two months (Paraguay, S.A. with 100 mW), and lots more fun. It is much easier now with the new antenna, much like having about six elements up there without all the hassle and mechanics that would require. By the way—it only goes up 16.5 feet in the air for you non-climbing amateurs!

Build It—Hang It—Get It On

See Figure 1. The actual construction is best covered by the pictures and drawings, but I will verbally walk you through it as well. One cardinal rule: PVC pipe is *great*. It will give you a lot of fun, it is inexpensive

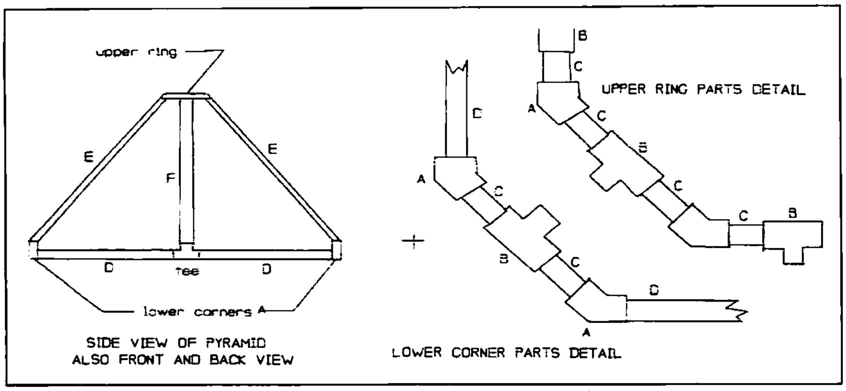


Figure 1. Beginning the Pyramid Antenna's assembly. (See text.)

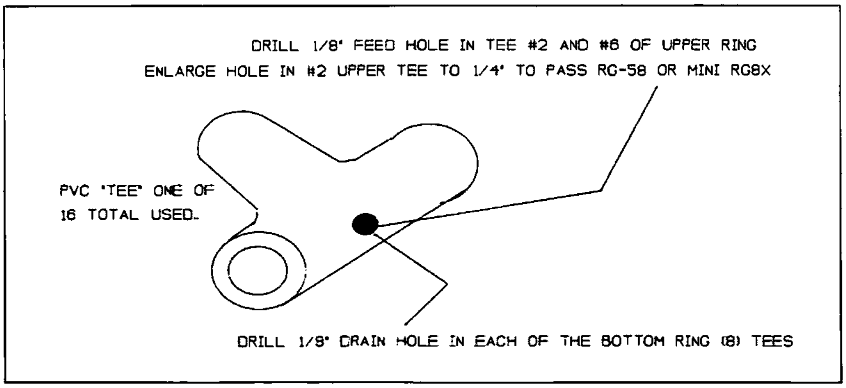


Figure 2. Drilling the Pyramid's "T" holes.

construction material, and is quite forgiving in all but one way: Whenever you get ready to glue two parts together (cement, to be technical), *make sure you mean to do it!* This stuff puts epoxy to shame. The process you are using actually bonds the two pieces by fusing, so it is not just a glue joint. When you are done, you will have a one-piece antenna. I can't impress that often or strongly enough. The materials and cement are quite safe to use if you follow the directions, and by all means do pre-fit *everything*, no matter how sure you are that your cut and gloop shot will work. Begin by cutting all the parts except the four I will cover later: the shorter uprights at the center of the sides. The easiest parts are the corner uprights, part "E," because all you do is buy them, bring them home in their full 10-foot-long glory, and use them—no cutting required.

Next, you do cut some tubing, and I recommend using a hacksaw or backbow saw with fairly fine teeth. Something you would use on metal tubing or aluminum will work fine. Use of a saber saw in this day of electrical aid and abetting is quite all right, but not necessary. There are not all that many cuts to make. In order to practice your cuts, we'll start on something simple but necessary. Try very hard to keep the cuts 90 degrees, or a cut straight across the tubing. This eases matters a lot when you go to put them into the joiners later. Take one piece of tubing and clamp it firmly, but gently, into a vise or firm clamp. Then proceed to demolish it by practicing your cutting and making 24 pieces that are two inches long. I will admit that absolute accuracy in the length is not required, but in order to end up with a nice symmetrical antenna, neatness *does* count.

Now that you are a real pro at cutting (hey, there *is* a knack to it), we can move on to the only other cutting required. (See, I told you this was also an easy antenna. Just remember the GLUE thing, OK?)

Take eight pieces of PVC tubing and cut the store length of 10 feet down to eight feet long. If you already considered yourself capable of cutting the 2" pieces above, then yes, you could have cut them out of the two-foot pieces that are coming off these 10-foot pieces and saved buying one piece. I just want to be sure you are comfortable working with PVC, and offer the information that you can do it either way. When you are finished, you will have the eight necessary pieces marked "D" in the drawings. Right now I will tell you that no matter how neatly you saw, the edges are going to end up rough, and the hole inside somewhat plugged. Sand all edges smooth and clean out that hole carefully with either a box cutter, an X-acto knife, or the sharp edge of a common screwdriver. Do each one *as you finish cutting it,* or sure enough, you will miss one, and later that becomes critical.

Now you get your first try at playing in the glue pot, but I'll let you get your feet wet slowly. That is a joke, and it pays to keep the cement *off* of you and *on* the pipe, though my skin does not seem to mind small amounts accidentally spilled if it's cleaned off quickly. This is not, I am happy to say, like working with some of the super-glue which, if it hits your skin or you put your fingers together, makes you "welded" for life!

It likes the PVC a lot, but your hands are reasonably safe. Do pay very close attention to the can directions and, of course, keep it away from your eyes and the like. Begin the actual assembly by picking up eight of the 45-degree "L" pieces, part "A," and cementing them to each of the eight pieces you just cut to eight feet long, part "D." If you follow the can directions at this stage you can't go very wrong. Be sure the part is seated well, and follow the 1/4-turn instruction to help that, like screwing a nut onto a bolt. By the time you've done one I'm sure you will be impressed with how fast the cement sets up.

Continued on page 18

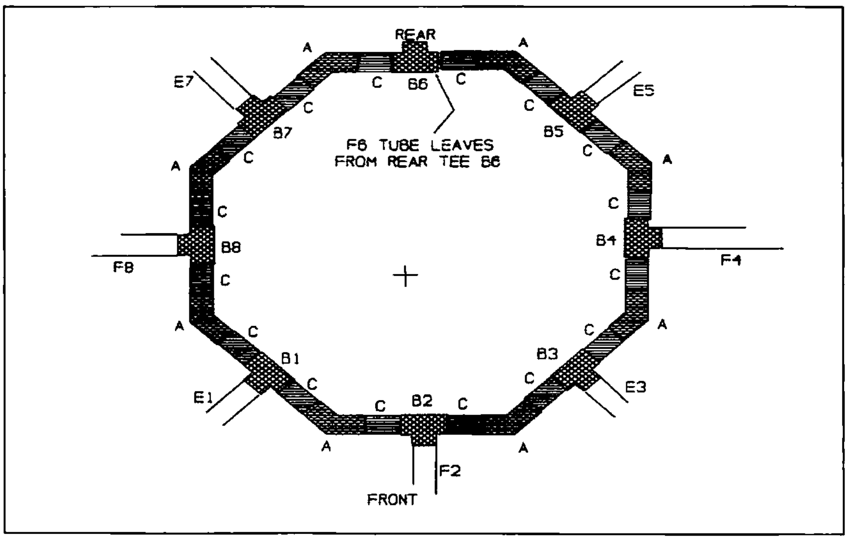


Figure 3. Pyramid's upper ring detail.

The Pyramid Antenna *Continued from page 16*

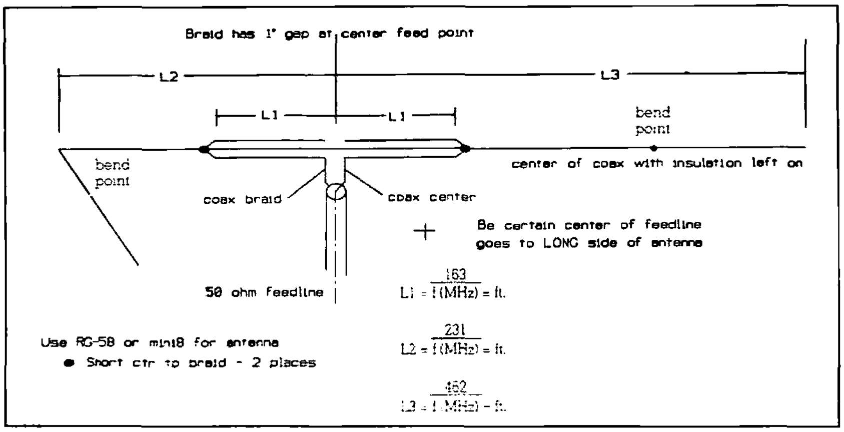


Figure 4. Pyramid's bazooka feed detail.

Five-minute epoxy, my foot! This stuff is, for all practical purposes, instant. It is for that reason I want you to follow along with me slowly and work your way up to the final assembly, where things can get really complicated unless you really appreciate the speed at which this cement works. Into the opposite end of each "L," cement a two-inch section of tubing. This will use up eight of your "C" parts, and at this point you should have eight assemblies of C-A-D sequence.

Now that you have become an expert gluer-upper, we can tackle another eight-to-eight assembly that is also non-critical, and is the miniature of what you just did with the eight-foot tubes. Take eight more of the 45-degree "L" pieces and cement them to eight of those two-inch pieces you cut off first.

One more easy step: Take eight more two-inch pieces and cement them into the other end of the 45-degree "L," part "A," just completed. Now, put the lid on the cement and *put it away* for now. That is for your own good, I promise.

Take 10 of the "T" part "B" pieces and drill 1/8" holes in the back of them directly opposite the larger opening (see Figure 2).

Enlarge one hole to just over 1/4" to pass the RG-58 feedline you will add later. This becomes "T" number 1 in the drawing. In the next assembly paragraph, use a second of the drilled "T" parts as number five. All the other "T" parts in the upper ring are undrilled (six, total).

Next, we need to do a little practice assembly, and since the top of this Pyramid is just a mini-version of the bottom, we will begin by assembling the top ring. Note: Assemble—do not cement. Press-fit a "T" onto one end of the eight 45-degree "L" part "A" just done, and then press-fit another into the opposite end of the "T." Continue alternating "T"s and 45s with two straights until you form a complete circle. The whole thing should be just flexible enough to fit the last pieces together without distorting or stressing the overall circle too much.

If you follow the diagram, you will end up with a circle of parts in a B-C-A-C B-C-A-C sequence all the way around, and have eight "T" parts "B," eight "L" parts "A," and 16 straight two-inch pieces, parts "C." Do the assembly on a flat surface and leave the "T" pieces heading straight out from an imaginary point at the center of the circle (for now). Be sure you have the numbered "T" parts (one and five) where they belong in the ring.

Now you can go for broke and assemble the lower ring. It goes very much the same as the upper ring. The exception is that the "L" 45-degree "A" parts now have parts "C" and "D" in each in place of the much smaller upper ring C-A-C combinations, so a bigger ring will result.

The easiest way to assemble the lower ring is to first find an open area in the shape of a square about 20 or more feet on a side. (Two-car garages are great, but I don't have one, either.) Any flat open area will do. By *press-fit only*, assemble the lower ring, following the diagram shown in Figure 3. I found it easiest to put the eight-foot pieces into a "T" and build each side, and then assemble the corners. Any order is all right, just *don't glue things yet.*

Mechanical to Electrical

Do the first cut on your feedline by cutting a piece of RG-58 to exactly 13.0 feet long. This is 1/2 wavelength at 10 meters, in coaxial rather than free-space terms. Continue on to the dipole.

Now is the time to build the "real," or electrical, parts, of the antenna. You can see by Figure 4, and the references to the two other antenna articles listed at the end of this article, that I have at last found a matching device for dipoles that works, is super-easy to do, requires *no* setting, and has *never* ended up with higher than 1.2:1 SWR on any I have made. Re-checking that one even proved that I just plain did not measure accurately. Do it right the first time and you will have no problems, I assure you. Taking just the outer insulation off the dipole center, then splitting the braid, and lastly soldering the feedline to it is admittedly delicate work, but just take your time and follow my sequence of doing it. First look over the diagram carefully and study it until you are sure just what is being done, and are familiar with all the dimensions. Then cut the insulation as shown, move inward and cut and remove the center one-inch of braid and solder the feedline to the feed point. The ground braid side of the feedline solders to the braid on the shorter end of the bi-square. The center conductor solders to the braid on the longer side of the antenna. Follow the diagram closely, as this is the easiest place to reverse something and end up with a dud instead of a winner.

When all that is done, half of the electrical work is done—the hard half. For the reflector element you can use copper wire in #14-#18 gauge, just like light-duty house wire. #10 or #12 is usually used for houses nowadays, but is a bit heavy, and does not work a bit better—I tried it! If the wire has a coating or insulation you will have to remove an inch or so at the reflector feed point in order to solder the reflector feed wire to it. Another good wire material is TV twinlead. Run from the hub at the center of the upper hub down the back center tube "F" part. Then solder another piece of twinlead as shown that is one wavelength in length on either side. That is fed out the back tubes of

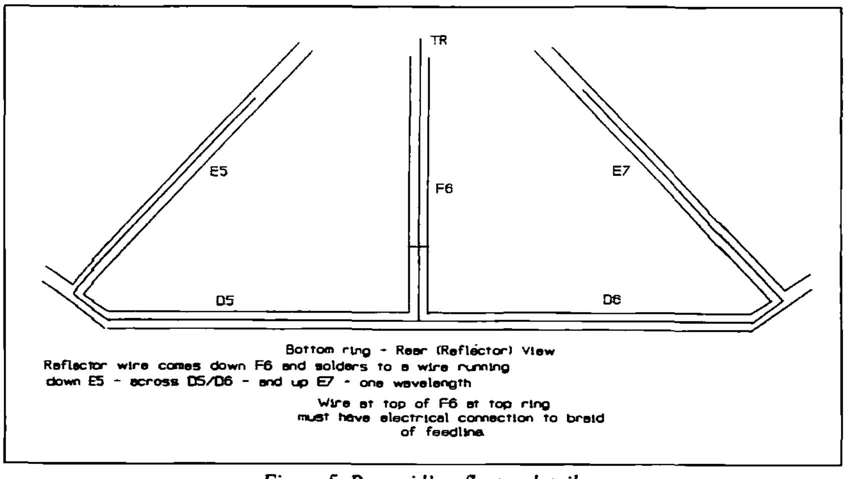


Figure 5. Pyramid's reflector detail.

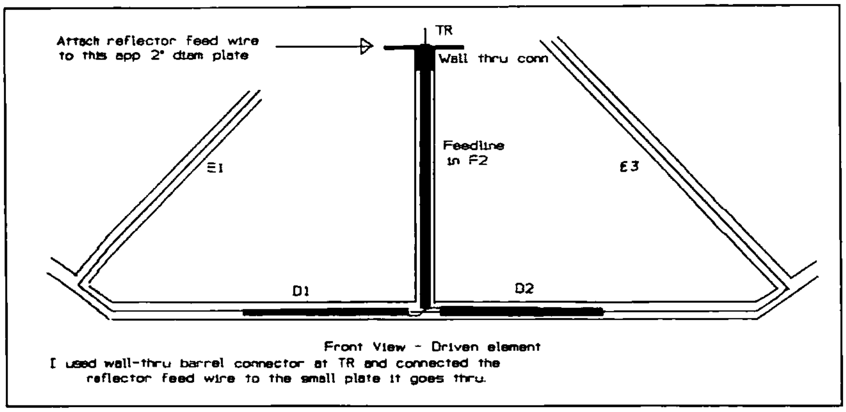


Figure 6. Pyramid's feed detail.

the lower ring, turns, and continues about two-thirds or more of the way back up the back corner tubes. The shape is like a large triangle, not quite closed at the top, and fed at the bottom center (see Figure 5).

Sound Assembly

See Figure 6. It is now time to turn all these carefully cut and crafted pieces into a real working antenna. Take your time feeding the wires through the PVC tubes or kinks and cursing will result. I have found the old "tie a string to a fishing sinker small enough to drop through tubings, and then tie on the cable being pulled, and pull it" trick to work like a champ. If you are not a fisherman, and I'm not, it is still worth buying a sinker just for this job. It is the perfect size (you choose the right one), and shape (teardrop) to do the job. Now that you know all of the lower ring fits together, carefully take the driven leg "T" apart. Slip each half of the bi-square into the "T" open end and head each half out opposite ends of the "T." Be sure the shorter end goes out the direction of D1, and the longer end out the end in the direction of D2. Feed these parts of the antenna out through D1 and D2 respectively. Center the feed in the "T" between D1 and D2. When all is nicely centered, with no kinks, and a smooth-looking "Y" as in the feedline drawing, fill this "T" with RTV, a small amount at a time, working from the center outwards. This is your final weatherseal, so do it slowly and carefully. While the RTV is drying, go to the back center of the Pyramid to the "T" between D5 and D6. Run the reflector element through the correct D5 and D6 tubes. This will no doubt require disconnecting corners, so go all the way around the lower ring and disconnect all non-cemented connections. Remember, the first fit was just a trial fit. Now you are loading the antenna real parts into the tubes, and when reassembled the next time you will cement things together.

By the time you work the reflector wire through the back lower tubes and around the lower corners, through the correct "T" parts and up two more 10-foot PCV tubes that become "E" part back corners, the RTV should be dry. Leave the feed part of the reflector just lying on the ground and running toward the center for now. I found the next assembly to work for me after trying many different ways. Take any one of the 10-foot-long "E" tubes and lay it in the corner connecting the upper ring and the lower ring at point 1. You must now find a stable means to support the center ring about 3'4" off the ground. Small stepladders are just about close enough, or some kitchen stools, sawhorses, or whatever means you have to support the ring at this height. Now fit the #1 "E" tube into the "T" at #1 upper ring corner and cement it into the "T." *Do not* cement any other part(s) of the "T." Do the same at the corner "E" tubes at #3, #5, and #7 corners. You can cement any "E" tube into its "T" at each corner—but not other parts of the "T." This is very important, as the "T" parts of the upper ring eventually must slope downward at about a 30- to 40-degree angle, just as the "T" connections at all the lower ring points must slope upward. The exact amount you will next find out by actually forming the Pyramid. Take each corner 1-3-5-7 in turn and cement the "T" of that corner at the lower ring "T" point. Be careful not to spill any cement into the lower "T" fittings and thus welding the "T's" ability to rotate upward. When four corners are done, you will have a Pyramid top and sides, and as you reassemble the lower ring pieces, the lower ring will come back together. Go around the lower ring cementing *only* the corners at 1-3-5-7, and being sure the "T" at each of those corners slopes upward directly toward the upper ring. The tubes do bow a bit, so try to keep a line through the lower "T," a corner tube "E,' and its upper ring "T" as a straight line, as that removes a lot of twist stress when the antenna is later hung from the center of the top or upper ring. Leave the "F" tubes and center front/rear/sides "T" parts *not* cemented. Using the four remaining PVC tubes, make your "F" tubes by cutting them as follows:

Turn the "T" on the lower ring and the upper ring to face each other, much the same as you did the corners. Now measure between the open ends of the upper and lower "T," and add one inch. The add is for the 1/2" that goes into each "T" at each end of the tube. This is a careful measure-and-fit operation, but not critical. If it's just a bit short it will bow the Pyramid's base upward a bit at the center sides. If it's a bit too long, it will bow it downward. These tubes are mainly mechanical support to prevent sagging between the corners. Mine were cut to fit, and if you do all your other cutting carefully, that should work for you as well. Slip one of these over the reflector feed wire at the back center, and feed the other end out through the upper "T" at #6, where the second upper "T" with the hole is located. If twinlead is used, or larger gauge wires, etc., then you may have to enlarge this hole to suit, or solder a wire to feed through the hole onto the reflector feed. You are trying to reach the center hub, where these wires will ground the reflector to the mast, coaxial feedline shield, and all grounds. Do the same with the coax feedline through the front "F" tube running between the upper "T" #2 and the lower "T" #2 that got the RTV filling. This gets the feedline back up to the upper ring and the mast.

When all this is in place, begin cementing these "F" tubes in place, upper and lower, all around the Pyramid at locations 2-4-6-8. A word to the wise at this point: When fully assembled, it can be difficult to tell a cemented joint from a tight joint under tension from all the other parts—until the whole thing falls apart when it's 16 feet in the air!

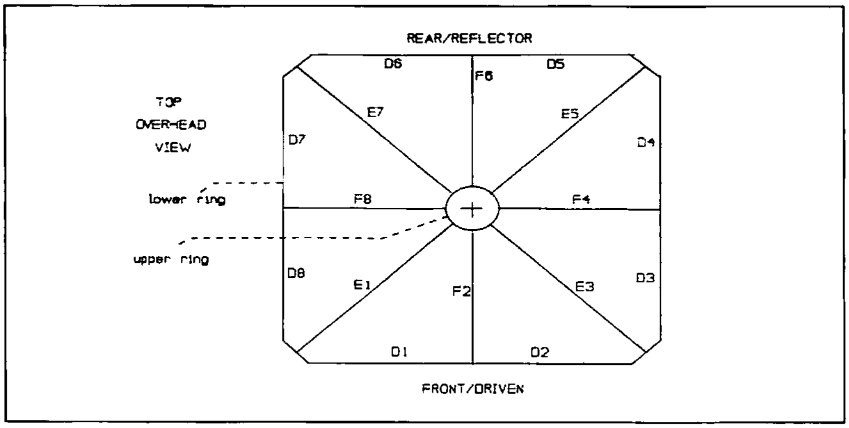


Figure 7. The Pyramid Antenna's overall design.

Do use some means to mark the outside of every joint you cement as you cement it. Tape you can later remove (black/red/yellow high visibility), or magic markers like that work really well. When you are finished and ready to raise the beast, you want to be able to do a walk-around-the-whole-thing inspection and find loose ends at a glance.

Assembly Tips

I discovered a few helpful hints on the final assembly trail, and hope they make assembly for you a lot easier than my first try (live and learn). When cementing the last of the bottom ring, give up any hope of the twist assembly method. Just coat the tube part, insert in joiner, and hold 15-30 seconds. The same holds for all the final assembly of the upper ring, which you can now do. Just coat all the way around the tube for about 1/2" that is going into the joiner, and insert the tube straight in, keeping the overall ring flat.

For those of you with machining and aluminum plate at your disposal, the mounting plate for the upper ring could be 1/4" aluminum plate. I have no such source, so 3/4" marine-grade plywood has done well for me for years. Use a piece 2" larger around than the ring's outer diameter, and give the wood several light coats of marine-grade varnish or other weatherproofing material. Rustoleum "Wood Saver" paint also seems to do well, but is a relatively new product, and I'm just now doing some testing on it myself. After the first few soaking coats of whatever you decide to weatherproof with (aluminum users skip on), drill holes to pass the legs of U-bolts that will wrap around each part "C" in the upper ring and through the plate (16 in all). These can and should be light-duty 3/16" variety U-bolts used throughout the TV antenna industry and available in most hardware and discount stores. Heavier U-bolts would have been fewer in number maybe, but harder to find and of a strength really not necessary. Using the lighter version U-bolts allows more distribution of the stress points where the antenna mounts, and spreads that stress when the wind starts blowing things around. To be sure, the antenna will bob around a bit in the wind, as overall it is quite light for its size. Not to worry, mine made it through 64 mph winds this year, and kept on tickin'. Mounting from the plate to the support mast is left to the user, but I found floor flanges to work very well. Take time to find aluminum types used in office/factory handrails and pallet shelves if possible. They don't rust, and tend to have higher collars on them. The latter I like to drill and tap holes at 120-degree spread around the collar and run into them 3/16" to 1/4" bolts about 1" to 1-1/2" long. This stops the obvious, "If I can screw it onto the upright mast, the wind can surely 'unscrew' it!" Take time to seal the plywood edges, if used, and whatever you do, do not use any kind of chip or particle board. The strength is just not there.

I hope you find the antenna as easy to build and as much fun to use as I have. At only 16.5 feet up (through the center line of the lower ring), or about 20 feet even at the center plate, it is quite a worthy performer. It took quite a bit of fiddling to decide how much reflector to use and where to run it, as well as the guts to try this type of a driven element, but I had all those years to evaluate all the smaller parts of this antenna. I even built scaled-down VHF models for the first time in my life, and hey, scaling does work—sort of. And if all else fails, and the band goes all quiet, you can always go sit under it (power OFF of course), and test the other theories of pyramid power.

If I can help you in any way, just drop me a line (14670 N. Cumberland Rd., Noblesville, Indiana 46060). Please include an S.A.S.E. and allow a few days for me to to digest your question and reply.

References: Charles Whysall W8TV, "The Double-Bazooka," *QST*, July 1968, p.38.

John Schultz W2EEY, "The Double Coaxial," *73 Magazine*, June 1973, p.79.

Parts List and Specifications

Type of pipe/tubing used: White PVC plumbing pipe; 1/2" Crestline (or equivalent), schedule 40, PVC 1120, 400 PSI. Black and gray are usually sold as electrical conduit. There is a tan PVC that is for hot water and is higher in cost, with no increase in value as used in this project. Overall, the white PVC cold-water pipe is the least expensive, and is more than sufficient for strength.

Cement used: Hercules brand, clear, PVC, medium body, medium set plastic pipe cement; up to 6" diameter; schedules 40 & 80.

Parts:

PVC tubing as above	1/2", white, app. 7/8" o.d.	17
PVC connectors	45-degree, ELL	16
PVC connectors	Three-way joiner, T	16
Can of cement	To join tubing and joiners	1
3/4" plywood	Marine if possible, app. 24" x 24"	1
Pipe floor flange	Minimum 1-1/2", four-hole mounting (to suit vertical support pipe coming from rotator	1
U-bolts	Aluminum or plated hardware, with legs long enough to encircle tubing and go through plywood mounting plate, app. 1-1/4"	8
Coaxial cable	RG-58, solid-center conductor	App. 50 ft.
RF connector	As appropriate to connect to lead-in to shack (BNC fittings were used, but PL-259 type are adequate)	1

Approximately a pound of care and patience (be sure to prefit and try everything before you glue—the glue works, last)

Number 6 on your Feedback card

Using GE Progress Line Receiver Strips

A low-tech solution for many situations.

by Robert B. Whitaker KI5PG

Like most hams, I am a terrible pack rat. I hate to get rid of anything that still has some use or value left in it. In recent years, manufacturers and advertisers have done a good job of convincing us that we always need the newest, highest technology gear to solve our problems. Often, however, we don't need state-of-the-art equipment to meet our needs. In many situations, a simple and inexpensive solution is just what is called for. This article will describe how to use General Electric Progress Line VHF and UHF receiver sections as practical stand-alone receivers without bulky cables, control heads, and heavy cases.

General Electric designed and produced the Progress Line series of radios back in the 1960s. These radios were widely used and are still widely available today at very low prices. I've talked to a number of hams who still use these old radios and are very pleased with them. I will not cover the transmitters since they use now-scarce vacuum tubes for the power amplifiers. Perhaps another writer can pick up that topic.

These crystal-controlled receivers can be used for quite a number of practical monitoring purposes, such as monitoring local repeaters, weather radio broadcasts, and police or volunteer fire department frequencies. They also make excellent receivers for repeater systems or control links for repeaters. Some receivers have an optional subaudible tone access (called Channel Guard, by GE) which is especially well-suited for repeaters or control links.

Where to Hunt for Older Radios

These GE Progress Line radios, like many older radios, can commonly be found for rock-bottom prices at swapfests, usually for $15 or less. Manuals, which are a little more scarce, can often be picked up at the same time. Other good sources for the radios are local commercial radio dealers. Many dealers will just give them to you to get them out of storage. If your city or county has surplus equipment auctions, you will find these and other good radios at great values. Even used commercial vendors sell these radios at good prices. Shipping weights increase costs for mail order but these dealers will often have a wide selection of radios and just the proper tone elements, accessories, or manuals.

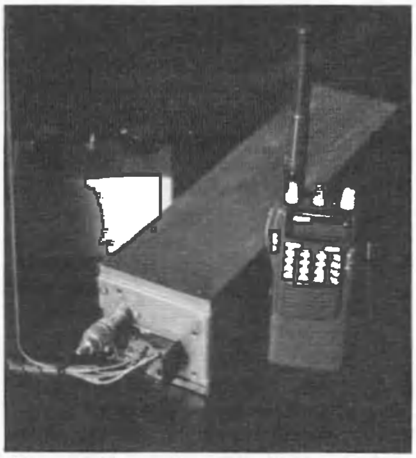


Photo B. The receiver strip shown wired for permanent use.

I spoke to one ham in California, John Lansdell WA6HRH, who has almost 100 of the Progress Line radios. He offered to sell the whole radios, or just receiver sections alone, at a ridiculously low price. John's phone number is (909) 873-1319.

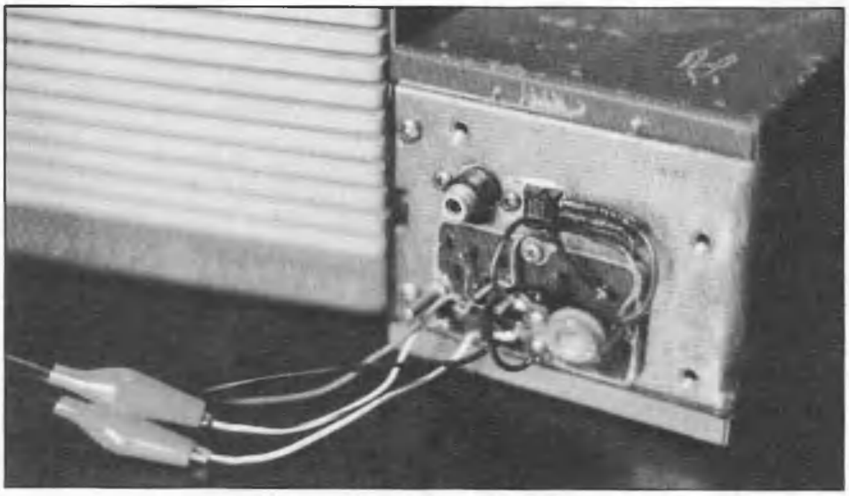


Photo A. The receiver strip test plug.

Wiring the Receiver Strips

The same receiver strips for the Progress Line series were used both in mobile radios and in base stations or repeaters. They are easily interchangeable. The VHF and UHF models are identical in their outward appearance, and wiring for either band is the same. The receivers are all solid-state and have held up well over the years since they were manufactured. They require only a handful of parts for separate (external) operation. A 10-volt regulated power supply, a 13-volt power supply and trimpots for volume and squelch controls are all that are needed.

The regulated +10 volt power is easily supplied with a 7810 regulator. The 7810 is a little harder to locate than the more versa-

tile 317 regulator but it has a couple of advantages over the 317 regulator. The 7810 does not require a resistor network to set the voltage output as the 317 regulator does. Also, unlike the 317 regulator, the 7810 can be attached directly to the receiver strip case without an insulating spacer since the heatsink tab on the 7810 is the negative common connection. The receiver +10 volt current draw is only 150 miliamps but the regulator will run fairly warm without fastening to the receiver case for heat sink. The only stage of the radio requiring 13 volts is the 5 watt audio power amplifier.

Figure 1 shows the pin outputs of the receiver. If you have a number of the strips, you might want to find a separate plug to use as a test wiring harness, as shown in Photo A. For permanent use you can simply solder connections directly to the pins as shown in Photo B. If your receiver has two or more channels you will need to select the desired channel by strapping that channel pin to +10 volts. The single frequency models are wired internally and do not require this connection.

The receiver remains muted until +10 volts is applied to pin 2, Receiver mute. As originally designed, the +10 volt power was removed from this pin when the transmitter was keyed so the receiver would not operate during transmitting.

If your receiver has the optional channel guard board and a tone element you can invoke channel guard operation by connecting pin 18 to ground. In this mode the receiver will remain muted or squelched except for signals with the correct subaudible tone frequency.

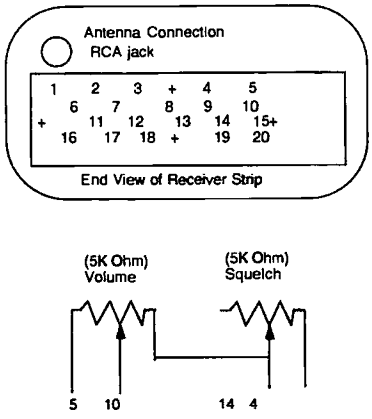
Tuning the Receivers for the Ham Bands

Tuneup on the radios is fairly straightforward. Experience definitely helps, but even a neophyte (like me) can get the hang of it. The information in the sidebar gives basic tuneup directions for the front end of the radios. You don't need a complete test bench with a lot of expensive service equipment. A decent multimeter and a synthesized handheld or mobile radio for signal generation will usually suffice. For complete tuneup, refer to the GE maintenance manual. Most of the VHF strips around these days were designated for VHF operation from 150 to 174 MHz. These receivers almost always will tune down through the entire 2 meter ham band without a problem. The UHF receivers designated to operate from 450 to 470 MHz will also tune down to 440 to 450 MHz operation without problems. GE conveniently provides a test jack for measuring voltages and signal levels in different stages of the receiver. The sidebar describes tuneup techniques for the poor man without access to expensive test equipment.

Using the Receiver Strip in a Repeater System

The metal shielded cases and reliable design of the GE Progress Line receivers make them ideal for repeater use. At a time

GE MASTER PRO Receiver strip connector for both UHF and VHF designs



1. Ground
2. Receiver Mute (+10v)
3. Encode Out
4. Squelch High
5. Volume high
6. Frequency 1
7. Frequency 2
8. Frequency 3
9. Frequency 4
10. Volume Arm
11. +12 Input
12. Regulated +10 Input
13. System Negative
14. Volume Low/Squelch Arm
15.
16. Speaker Output 1
17. Speaker Output 2
18. Channel Guard On-Off
19. C.O.S. Feed
20. Monitor Lock

Notes:

1. Connect power leads, volume control, squelch control, and +10 volts input as shown. Connect +10 volts also to Pin# 2 (Receiver Mute) and the Pin to select the frequency if the receiver is a multi-frequency receiver
2. +10 volts should be accurate and well regulated. Use +10 volt 3-terminal voltage regulator or 317 type.
3. On multi channel strips connect frequency select pin to +10v.
4. For Channel Guard Operation (PL) connect Pin 18 to Ground
5. Disconnecting Pin 2 from +10 volts will mute the receiver during transmitting.

VHF MODELS ER-41-C and E
Crystals are GE Part # 19B20657P4
Crsytal frequency = (Operating Freq. - 5.3 Mhz) divided by 9

UHF MODELS ER-42-E and G
Integrated Circuit Oscillator Module (ICOM) are GR Part # 4EG26A10
ICOM freq = (Operating Freq. - 12.4 Mhz) divided by 24

Figure 1. GE Master Pro Receiver strip connector for both VHF and UHF designs.

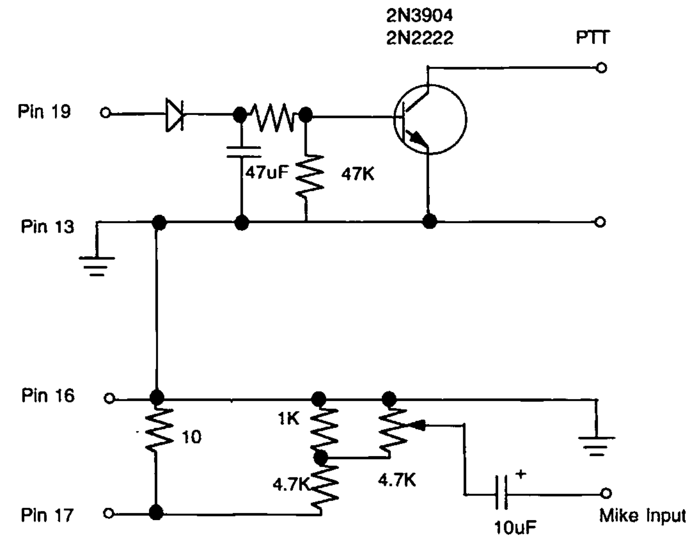


Figure 2. GE Progress Line repeater interface.

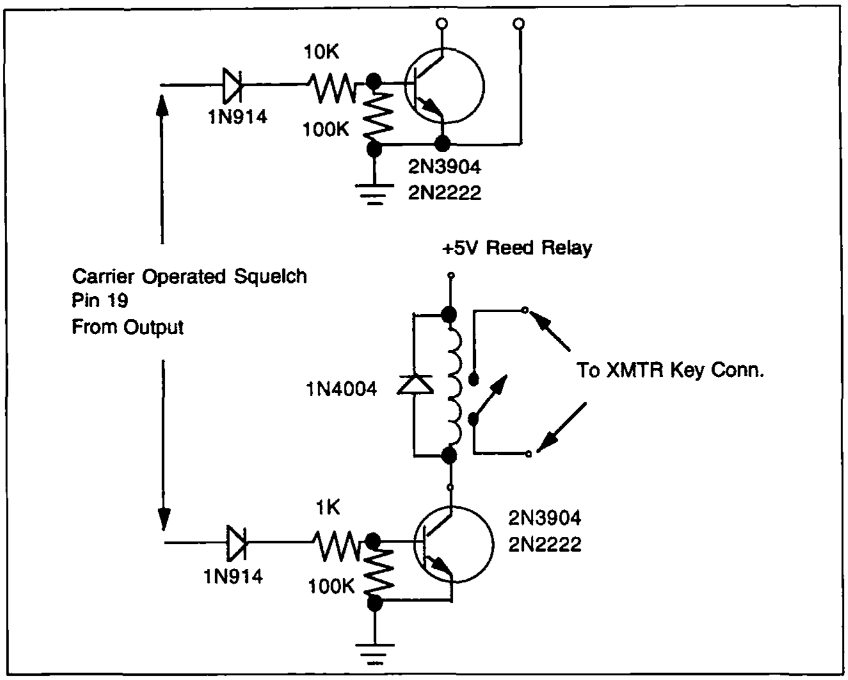


Figure 3. Transmitter keying schemes: a) Open-collector NPN switch, b) Alternate technique using a reed relay.

when many area coordinators will not assign repeaters without subaudible tone access, the Channel Guard option for these receivers is a valuable bonus. A new tone decoder board would certainly cost more than one of these receiver strips with Channel Guard and tone element. The Channel Guard operation (CTCSS or subaudible PL tone) can be enabled or defeated with a simple switch between output pin 18 and ground. Figure 2 shows a simple interface for directing the audio output into a transmitter. Even if a speaker monitor is not used, be sure to use 10 to 20 ohm resistor across the audio output leads to provide proper loading for the receiver audio amplifier. The input level to the transmitter is set by balancing both the receiver audio level and the 10k ohm input audio level control. If subaudible tone operation is not used, a tap for audio could be taken directly from the high side of the volume control, pin 5 on J443. This point, however, would be raw unsquelched audio, with any unfiltered subaudible tone present. A capacitor is used for audio coupling and DC isolation.

A carrier operated relay (COR) for keying a transmitter is also relatively simple. Pin 19 of the Progress Line receiver connector plug is a carrier operated squelch feed. This line outputs about 3 volts when a signal is received. An alternative method of keying the transmitter using the absence of voltage could also be employed. Pin 20 of the receiver, labled monitor lock, normally presents about 8 volts when the radio is squelched but the voltage on this pin falls to near zero when a signal is received, regardless of Channel Guard setting.

Two very simple keying techniques are shown in Figure 3. In the first case (Figure 3a) an NPN switching transistor is used with an open collector circuit for most transmitters which key by taking the PTT line to ground. The voltage from the radio forward biases the transistor causing the emitter to collector resistance path to fall very near zero and key the transmitter. In the other diagram (Figure 3b.) a similar circuit operates a relay which keys the transmitter. A slight delay or repeater tail could be achieved with an added resistor/capacitor network. Varying the component values

Parts List

1 7810 +10 volt regulator	Mouser Electronics part No. L78S10CV or equivalent	
2 5k ohm trimpots	Mouser Electronics part No. 320-1510-5K or equivalent	
Optional parts for repeater control and interface:		
10 ohm resistor for loading	Radio Shack	
5k ohm trimpot		
1k resistor		**Sources**
4.7k resistor		Mouser Electronics
1N914/4148 (or similar) diode	RS#276-1122	2401 Hwy 287 N.
2.2 to 10 µF capacitor for audio coupling		Mansfield, Texas 76063—4827
2N2222A or 2N3904 for COS keying transistor	RS# 276-2009	1-800-346-6873

Crystal Manufacturers
(This is not a complete listing, just a representative sample of suppliers.)

Bowmar
201 Blackford Avenue
Middlesex, New Jersey 08846
1-800-777-2197

International Crystal Manufacturing Co., Inc.
P.O. Box 26330
Oklahoma City, Oklahoma 73126
1-800-725-1426

Jan Crystals
2341 Crystal Drive
P.O. Box 60017
Fort Myers, Florida 33906-6017
1-800-526-9825

Commercial Radio Vendors

(Thanks to Larry N5DH and Harvey WB5MCT for these hints.) (Again, this is not a complete listing, just a representative sample of dealers.)

VersaTel
1-800-456-5548

C. W. Wolfe Communications
1113 Central Avenue
Billings, Montana 59102
(406) 252-9220

Ordering GE Manuals & Parts

If you need a manual or parts for any GE manufactured radio and cannot get hold of one from local sources you can call:

For manuals: Ericsson GE Mobile Communications, Inc., Lynchburg, Virginia; (804) 528-7649.

The manuals are broken down into subparts, i.e. Exciter, PA board, Receiver, Audio-Squelch board, etc. Each subpart is generally $5. A full manual for a radio will run from $35 to $50, so try to find one locally, first! If all you need is one section, it is easy to just call Ericsson GE.

For parts: Ericsson GE Mobile Communications, Inc., Lynchburg, Virginia; (800) 368-3277.

changes the length of the tail. A light emitting diode (LED) could also be used as a visual indicator of a received and re-transmitted signal.

Extra Bonus for 9600 Packet Operators

These GE receiver strips make fine monitors of both 1200 baud and 9600 baud packet. For 9600 baud packet operation, the received signal can be taken from the discriminator output at pin 10 of the metering jack, J442. Usually they work just fine, but a slightly wider bandwidth can be achieved by soldering two short leads of wire across the crystal filter next to the output transformer under the IF-Audio & Squelch Board, and then twisting the ends together to form a capacitor to broaden the skirts of the filter. Having the capability of instantaneously monitoring your own signal and connecting to yourself on another packet stream for modem calibration and testing is a tremendous benefit, as anyone who operates packet knows.

Next time you need an inexpensive receiver or monitor, this vintage receiver may be just the ticket!

Tuneup Hints for the Poor Man

(Thanks to Larry N5DH and Harvey WB5MCT for these hints.)

Since the tuning range of the GE receiver strips is relatively narrow, any change of operating frequency of more than one or two megahertz will require retuning the receiver front end. Not everyone has a complete test bench with a wide range frequency generator at their disposal, but most hams have all the gear needed to retune receivers. Modern synthesized radios, either handheld or mobile, are very accurate frequency generators. The problem is generally that the radios still put out too much power even on lowest power settings. Using a 50' or longer length of coaxial cable makes a great signal attenuator. Rubber duckie antennas, dummy loads, or other less efficient radiators also help reduce generated signals down to acceptable levels for retuning radios. Another trick for tuning radios is to use a scanner for a signal generator. Check the scanner specifications for the IF frequency, usually about 10.7 MHz above or below the intended frequency. Often, tuning the scanner to this IF frequency above or below the intended frequency will generate an RF frequency which can be used as a signal for tuning the receiver.

The strength of the signal can be increased or decreased by moving the scanner nearer or father away from the receiver. The basic idea is to tune the sections of the radio using an unmodulated carrier until the maximum selectivity or radio opened squelch quieting (least noise) is obtained. As the receiver comes into tune, loosely coupling the antennas of the scanner (or signal generator) and the receiver will also attenuate the signal to the receiver until maximum quieting in the receiver is achieved. In some instances, as the receiver comes into tune it may be necessary to slightly detune an early stage of the receiver to determine the maximum tuning or selectivity of later stages.

J442 Metering Jack Test

pin#	Function
1	
2	2nd IF
3	1st Limiter
4	Multiplier 1
5	Multiplier 2
6	
7	Audio output #1
8	System Negative
9	
10	Discriminator
11	
12	
13	Regulated +10 volts
14	
15	Audio output #2
16	Ground

PTT Control from Receiver Audio

Here's an easy way to key a transmitter for remote or repeater operation.

by Roland Burgan KB8XI

Does this scenario sound familiar? You needed to key a transmitter when a signal came into your receiver, but there was no way you were going to risk voiding the warranty on your new radio. That very problem has canceled many a project.

Years ago, accessing the COS line (carrier-operated squelch) was fairly easy, allowing simple control of transmitters for repeaters, base extenders, etc. However, recent advances in technology have produced radios that make such tap-offs very difficult, even for the experienced ham. And the possibility of voiding a warranty is no longer something to scoff at.

I needed a way to key a transmitter upon receiving a signal, without invading the insides of my transceiver. Adding a permanent dangling wire was not appealing, and adding another jack was appalling. There are circuits that provide a signal from an audio source, but they all seem to need voice audio to develop a keying signal (VOX). But now there is a reliable alternative.

Various Uses

This circuit will be especially useful for putting together base/mobile/portable repeaters or remote operations. It will allow the use of equipment without your having to get inside and do circuit surgery. Also, this circuit will provide a switching signal for various devices or secondary units which need to operate when a signal (with or without audio) is received.

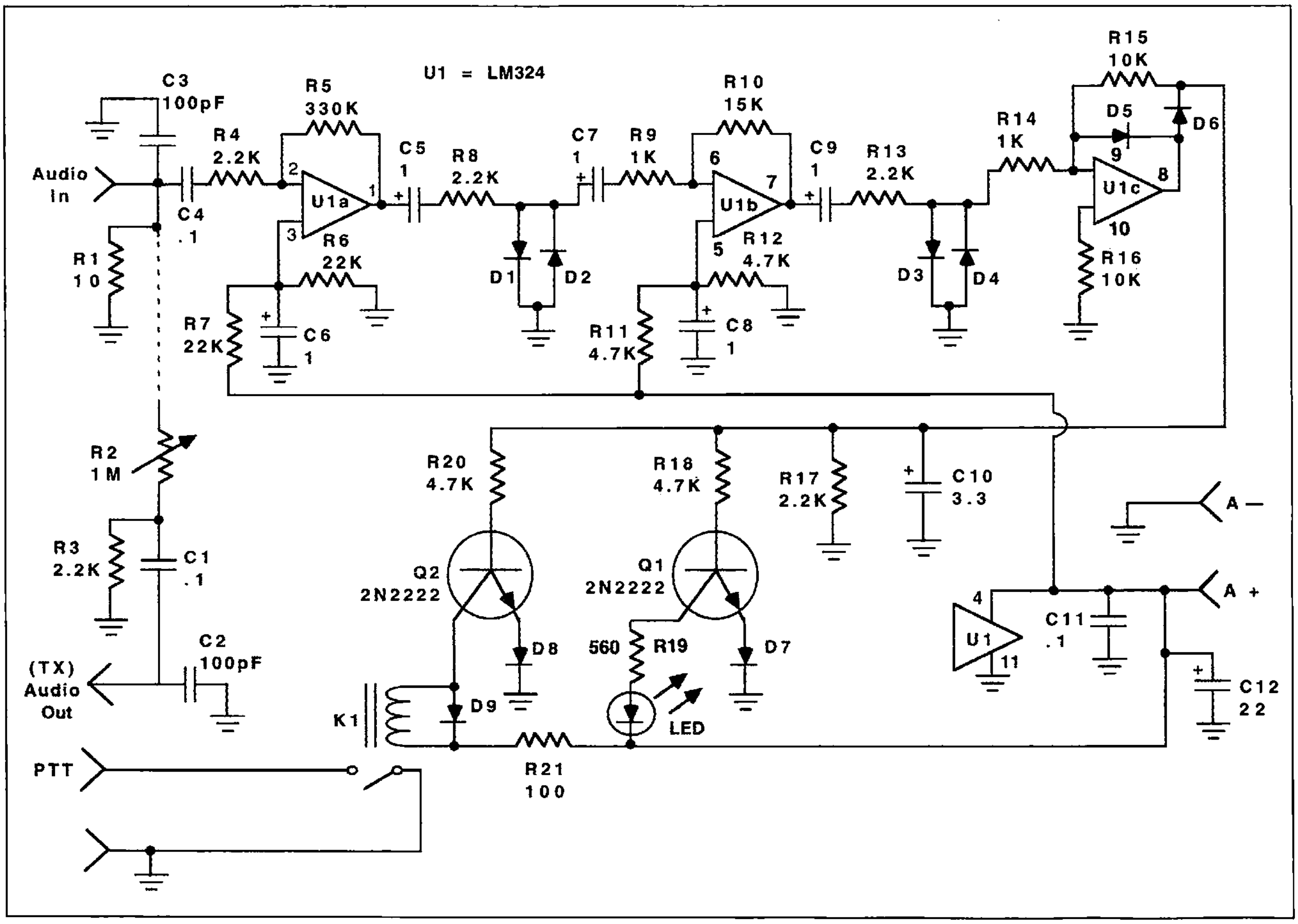


Figure 1. Schematic for PTT control from receiver audio.

Circuit Analysis

The circuit functions on the noise level difference between a full-squelched audio output and the audio noise level present when the squelch opens upon receiving an unmodulated signal. Measurements showed that, on average, there is about a 20 dB difference in levels, and the circuit uses this difference to recreate the COS signal voltage. Op amp U1a (Figure 1) amplifies the audio input, which is then clipped to 0.6V in the first of two clippers. Op amp U1b amplifies the resulting signal, which clips it a second time to 0.6 volts. The result of U1a & U1b is to highly compress and clip the incoming audio noise signal. This signal goes to U1c, which serves in a dual capacity. This op amp first functions as a precision rectifier, producing a DC voltage, and secondly acts as a DC amplifier, raising the DC signal to a TTL level. The TTL level signal voltage then feeds two NPN transistors, one controlling an LED to show status, and the other operating a 5-volt reed relay. A relay was chosen instead of electronic switching to provide reliable device control, especially in repeater/remote base applications. C10 acts as a smoothing filter for the DC signal. The slight time delay this also provides is negligible. Diodes D7 and D8 in the base circuits of the switching transistors will act to prevent false triggering. The LM-324 IC requires only a single supply of from 6 to 18 volts. The audio and A+ line are RF-bypassed. The total circuit gain is 22,500.

Audio Option

For convenience, I have included a transmit audio feed as an option. The variable resister, R2, allows the user to set the receiver volume control to some easily remembered preset point. Then adjust R2 for the required transmit 5 kHz maximum deviation. The 100 pF capacitor acts as RF bypass, while R3 sets level and impedance matching. If your transmitter is designed for high impedance mikes, then delete R3.

Construction

A printed circuit board for this circuit is available for $4.00 plus $1.50 S&H per order from FAR Circuits, 18N640 Field Court, Dundee, IL 60118. Construction may be either on a PCB or point-to-point—there is nothing critical to watch out for. An input sensitivity control was unnecessary because of the heavy signal clipping. However, if your audio source puts out more than 0.5 watt, change the power rating of R1 accordingly. If you intend use this with a transmitter, RF protection requires a metal case. If it becomes necessary to use a higher power supply voltage, changing the relay current limiting resistor (R21) from 100 to 220 ohms and changing the LED resister (R19) to 2.2k will allow operation from 16 to 30 volts (max) power sources. Low current requirements also allow the use of a 9-volt battery. All parts are available from Radio Shack and many other suppliers.

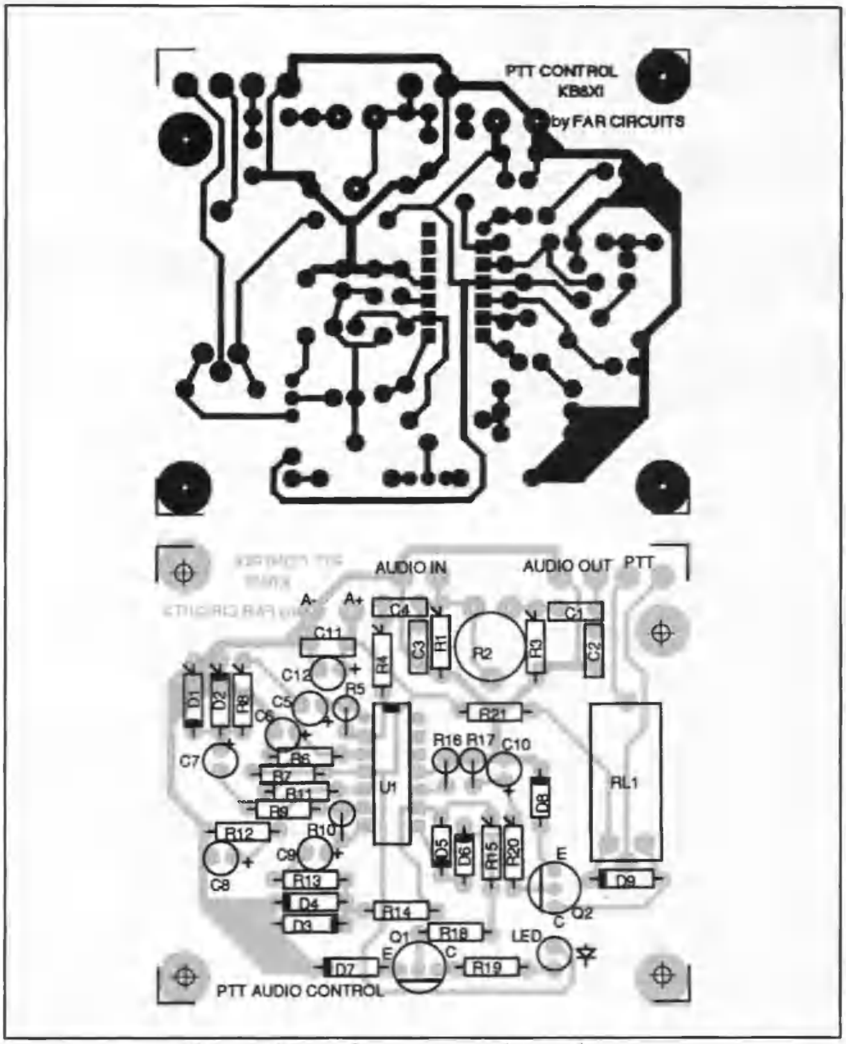


Figure 2. PC board etch pattern and parts placement.

Parts List

C1, C4, C11	0.1 µF, 50V	R/S #272-109
C2, C3	100 pF, 50V	R/S #272-123
C5, C6, C7, C8, C9	1 µF, 35V	R/S #272-1434
C10	3.3 µF, 35V	R/S #272-802
C12	22 µF, 35V	R/S #272-1026
R1	10, 1/2W	R/S #271-001
R2	1 meg. pot, 1/2W	R/S #271-211
R3, R4, R8, R13, R17	2.2k, 1/4W	R/S #271-1325
R5	330k, 1/4W	*R/S #271-1350, 271-1347
R6, R7	22k, 1/4W	R/S #271-1339
R9, R14	1k, 1/4W	R/S #271-1321
R10	15k, 1/4W	R/S #271-1337
R11, R12, R18, R20	4.7k, 1/4W	R/S #271-1330
R15, R16	10k, 1/4W	R/S #271-1335
R19	560, 1/2W	R/S #271-020
R21	100, 1/4W	R/S #271-1311
U1	LM324	R/S #276-1711
Q1, Q2	2N2222	R/S #276-2009
D1-D9	4001 diodes	R/S #276-1653
K1	5 VDC reed relay	R/S #275-232
LED	Any 2V LED	

*Note: Unfortunately, Radio Shack no longer supplies 330k resistors. Wire a 100k and 220k in series.

73 Review

Number 8 on your Feedback card

by Don Johnson K7UGQ

MFJ Enterprises, Inc.
P.O. Box 494
Mississippi State MS 39762
Telephone: (601) 323-5869
Orders: (800) 647-1800
Fax: (601) 323-6551
Price Class: $199.95

The MFJ-1796 Multiband Vertical Antenna

A lot of antenna in a small package.

Vertical antennas have the dubious reputation of being either loved or hated by members of the ham radio community. In simple terms, if the antenna is properly designed and installed, the vertical will provide creditable performance and, in certain instances, will out-perform a flat-topped horizontal wire. Because of its natural low angle of radiation, a vertical can haul in the DX better than a comparable horizontal flat-top antenna. However, for short, local contacts, its low angle of radiation coupled with "cross polarization" (theoretical 90-degree shift from horizontal to vertical), will perform somewhat less than a horizontal wire antenna.

Failure of vertical antennas to perform well is often attributed to two basic problems: poor multiband design and inadequate radial systems.

MFJ has introduced a family of autoband switching multiband vertical antennas that addresses both issues. Eliminating the need for radials through a design that electrically mimics a half-wave antenna and reducing losses common with end-fed trap verticals, the engineers have addressed issues responsible for most amateurs' poor experience when using vertical antennas.

Vertical Basics

A basic 40 meter quarter-wave vertical antenna is approximately 33 feet tall and requires a very good ground or counterpoise system to perform properly. In fact, the absence of a well-designed ground system is most often the reason horror stories circulate during vertical antenna discussions. The ground system must be electrically the same as the quarter-wave vertical section, on all operating frequencies, if any system efficiency is expected. Most ham urban/suburban homes do not have enough land, free of obstacles, to connect the several hundred feet of buried or elevated wire necessary for a good RF ground or counterpoise. An acceptable way to overcome the requirement for a cumbersome ground/counterpoise system is to center feed the antenna. However, a basic 40 meter center-fed vertical will stand prohibitively tall at approximately 66 feet.

A vertical can be short and still resonate at the designed frequencies by placing matching devices (loading coils and capacity hats) in each of the vertical elements. The location of a matching device can be at the feed point (bottom loading), in the middle (center loading), or at the end (end loading). While end loading is by far the most efficient of the three, it is also the most demanding for good physical design. A poorly-designed end-loaded antenna will surely self-destruct (cantilever) during a moderate windstorm.

Electrical Design

The MFJ-1796 is a center-fed or balanced-fed electrical half-wave vertical. In other words, a dipole antenna turned 90 degrees to the vertical. As a result, both half waves of the radiated signal are accounted for. At an overall length of 12 feet, loading coils and capacity hats for each band (40-20-15-10) are placed at the ends of each vertical component. This technique provides an electrical half-wave match while maintaining a small unobtrusive overall height. The antenna provides 6 and 2 meter performance through full-sized half-wave elements.

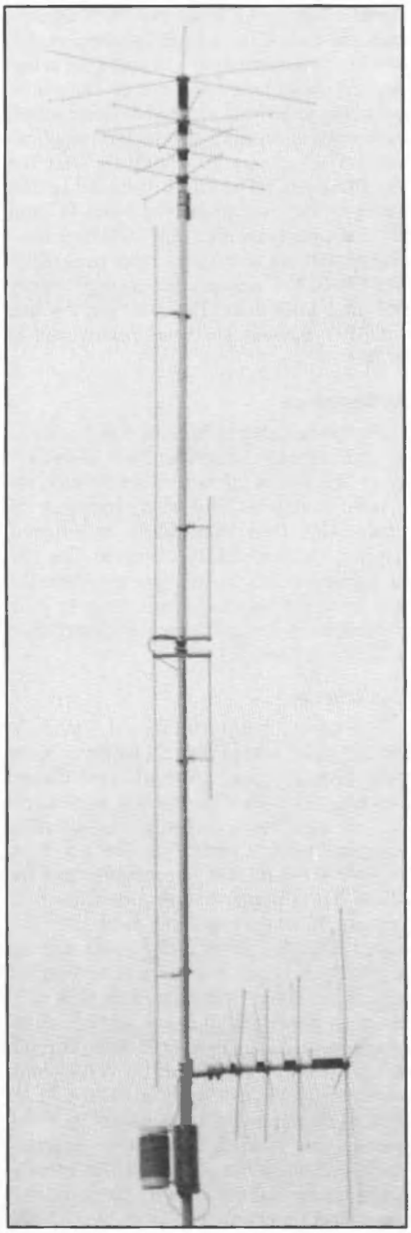
On the four HF bands, the antenna is designed to handle up to 1,500 watts of power, 750 watts on 6 and 300 watts on 2.

Physical Design

As discussed earlier, an antenna with end loading requires a very good physical design. Engineers at MFJ designed the 1796 with 1.16" diameter 6061-T6 aluminum tubing. The critical center and base insulators are made of reinforced Fiberglas, 1" in diameter. All coil forms are also made of Fiberglas.

A four-inch air-wound current balun mounted at the base of the antenna chokes off unwanted RF on the coax cable shield.

Various lengths of aluminum rods are used for capacity hats. Installation of the rods couldn't be made any easier. Once installed, they can be pruned or bent to fine-tune the different resonance points of the antenna.



Though somewhat fragile, the design of the capacity hat rods affords a substantial amount of ductility. The rods will not break under normal use. If accidentally hit during installation, they will deflect or bend. Real physical abuse is needed to break them.

Assembly

The 14-page manual offers step-by-step assembly instructions with several very clear drawings. Additionally, the manual discusses vertical antenna theory and offers hints for choosing a location for the antenna and tuning instructions. I strongly recommend that you follow the assembly manual exactly as written, especially the step that suggests that a temporary mounting or staging area be assembled before constructing the antenna. Once assembly begins, you will need a place to rest the antenna.

As with all MFJ equipment, the warranty explicitly states that the owner is authorized to attempt to repair any defective condition without affecting warranty coverage. A toll-free telephone number is provided for assembly or installation support if required.

Tuning

Nothing is more discouraging and frustrating than to assemble an antenna, perform frequency adjustment, and raise the antenna to height only to have to lower it for additional adjustments. The 1796 is designed to minimize this installation cycle.

As can be expected with a physically short antenna, the lower frequency resonance bandwidths are narrower and more sensitive to adjust than the higher ones. Range of operation (2:1 SWR points) on 40 meters is 40 kHz wide. Before any frequency adjustment is made, you should decide on what segments of the various bands you intend to operate in: CW, phone or somewhere in between.

If assembled per the instruction manual, the resonant frequency for each band will occur at or just below the lowest frequency for each band. For example, 20 meters should be resonant at approximately 13.9 MHz. To increase the operating frequency to the desired segment of the band, you must trim one spoke in each coil assembly. A chart is provided describing the effect of cutting one inch off of the spoke. If I wanted to raise the 20 meter resonant frequency from the assembled 13.9 MHz to 14.2 MHz, the chart says to cut three inches off of one of the 20 meter capacity hat spokes. Since this is a balanced vertical dipole, both sides of the antenna must be adjusted at the same time. I was able to hit my desired frequency, on all bands, the first time!

Extra spokes are provided in case you make you an error when cutting or should you decide to lower the initial frequency.

Comparisons

Antenna comparisons can be like comparing apples and oranges; they are both fruit, but are really different in many other ways. However, comparisons help make decisions, so here goes.

The MFJ-1796 works! How well it works depends upon several factors. Remember, the 1796 is not a multi-element beam, nor should one expect results to be comparable to a beam in any way. When installed 35 feet up and compared to a full-size 80 meter dipole (30 feet up) and a horizontally-mounted magnetic loop (35 feet up), comparable results were obtained . . . sometimes!

Because of two basic antenna facts, low angle of radiation and phase shift, the 1796 does not perform on local contacts as well as the magnetic loop or the dipole. However, if the local station is using a vertically-mounted antenna (same polarization), then the 1796 outperforms both of the other antennas. Because of the inherited low angle of radiation you should expect the 1796 to give a very good account of itself on long-haul DX. And it does. Stations 3,000 miles or so away were heard and worked when the dipole couldn't copy them at all.

The 1796 is a noisier antenna than either the dipole or the loop. In fact, if an electrical storm is within several hundred miles, you may not hear much of anything. This is not the fault of the 1796 but a typical characteristic of all verticals.

Several other things to consider when comparing antennas to the MFJ-1796 are: the small footprint (2 square feet), no radials, only 12 feet tall, lightweight, sound construction, and broad frequency coverage (40 meters through 2 meters).

Closing Comments

Remembering that the MFJ-1796 is a short (compromise) antenna, overall performance is less than a full-size antenna. Therefore, if you can install a full-size antenna, the 1796 is not your best choice. The engineers at MFJ have given serious thought in the areas of antenna design that increase efficiency in an effort to overcome the shortcomings of this type of antenna. If you are on a limited budget and/or must contend with restricted installation space, I strongly recommend the MFJ-1796.

The 80/40/30m Tripole

It's a WHAT?

by Dave Brown W9CGI

No, I did not grow a third element off of a dipole just for fun, nor did I name this project just to confuse you. Friends dubbed it the "TRI-DI-POLE." That may be more accurate, but was just too much of a mouthful for me to use as a title. The "TRI" simply reflects the fact that this is three antennas. The "DI" meant that all those antennas arc DIpoles. Last, the POLE just refers to the elements used in an antenna—and this one actually has six "poles."

My need for a low-band HF antenna came about when I at last received my Advanced license, after 30+ years a happy-camper Technician Class ham. I really did not study for three decades, it just took that long for me to care enough to give it a try. I got around the 20m-and-up bands I had gained by a simple multiband vertical requiring no radials. The challenge came in trying to fit 80/40/30m into my life. I do live on a farm, but even I don't have unlimited space, much less want the hassle of maintaining three separate feedlines, supports, and so on. While I was researching every "wire" antenna handbook I own or could lay hands on, I came across the very old idea of "cage" antennas. These are usually multi-element, but for only one band. That is, much like folded dipoles are used to raise input impedances, and not to get more bands covered. What if I were to build the simple 80m dipole to cover that band, and then in somewhat that cage manner mentioned, add the 40m elements and check all that out? Last, I could add the 30m sections and then be sure the other two bands still worked. My first try at that, I left "extra" at the ends of the dipoles to be sure—it is a trim-to-fit world we live in. You should not have to do that if you stay with the wire sizes and spacings given here, though leaving a bit over and trimming is always best if you want to be "right on"!

Not only did each other add-on band fit right in without disturbing the bands put together ahead of it, but there was also an added bonus! About a week after getting the 80/40/30m portions all up and going, I was thinking, "Now, what the heck do I do about 160m?" After all, a newly-licensed HF ham is out to try all the new real estate he can cover, as soon as he can cover it. I figured that if I used low power and tried the new tripole, I had nothing to lose. I have a Yaesu FT-990 with the built-in tuner, so some might say I could load a good salami if necessary. That was the case at first. The tuner was indeed used, *and* I stayed down around 10 to 15 watts. The funny part was that when I first tried it, the tuner light came on and went off almost instantly. That led me to think, "OH-OH, this may not be such a good idea!" It was not until I had some time a week later to further investigate that the tuner had shut off because the antenna was a good match, not because of high SWR or any such thing. Cautiously, I tried it with more and more power up to the 100 watts or so output of the FT990, and on tuneup it did just fine. Then the acid test: back to low power, meter in SWR position, and switch the tuner off. Still, the antenna loaded just fine on 160m with no tuner at all. With the

	CHW (feet)	CQW (feet)	CQW (ft. & in.)	SL (ft. & in.)	TL (in.)	FT (in.)
80m	121.875	60.9375	60' 11-1/4"	60' 6"	18"	17.5"
40m	65.455	32.727	32' 8-3/4"	32' 2"	15"	14.25"
30m	46.336	23.168	23' 2"	23'	12"	8.75"

Table 1.

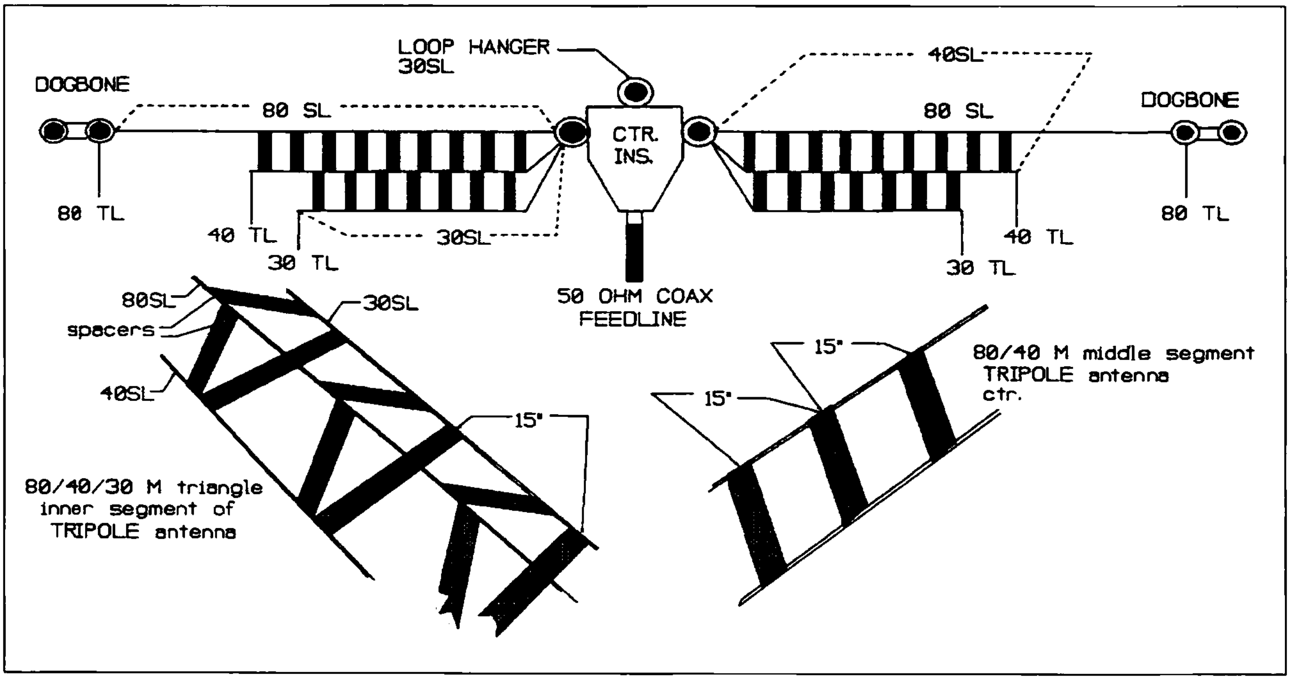


Figure 1. Tripole antenna assembly.

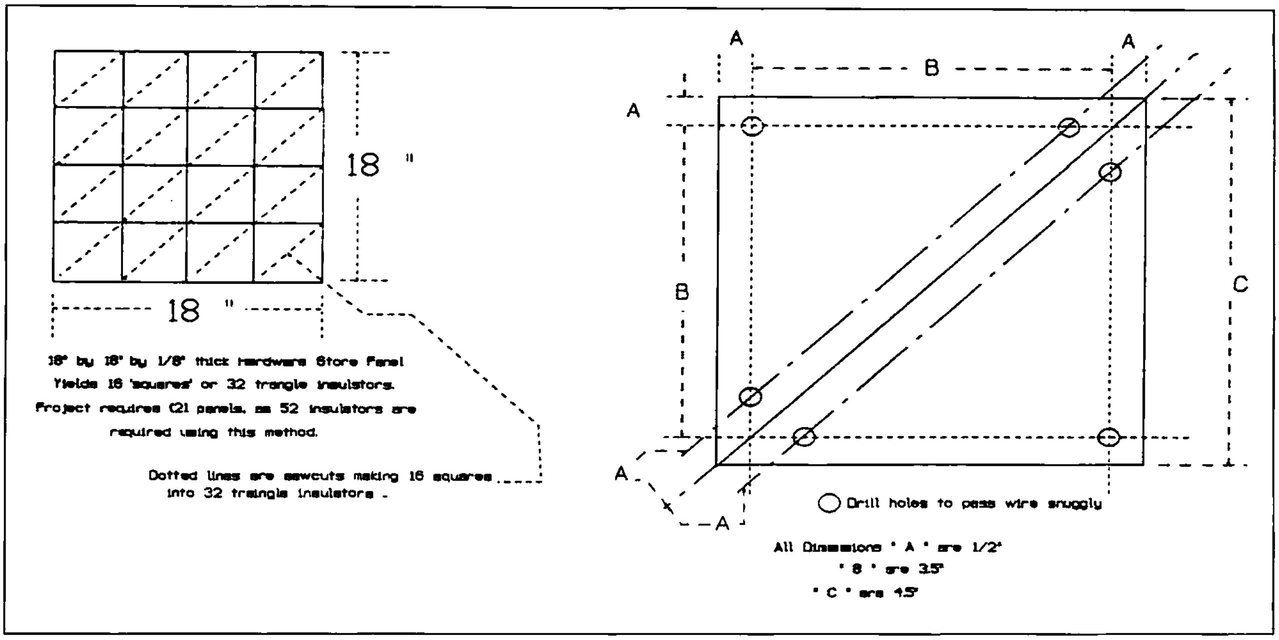


Figure 2. Plexiglas detail.

first three antennas I think I can explain the behavior being great after 30+ years of fiddling with antennas for VHF-UHF, but the exact *why* of the 160m working out so well is definitely beyond me. There are no known stub tuning or capacity effects of the 40 and 30m antennas affecting the full 80m dipole, but that seemed to be happening to some degree. Then, too, the way I put the whole thing up may have something to do with how it behaves.

How Big is "Big"?

In order to erect even a full-sized 80m dipole near my barn without looking like one of the Voice of America sites (awesome wire jobs!), I had to concede to a bit of creative wire bending. At first, my big concern was the effect the bending would have on the performance and directivity of anything I put up. That was just not to be, but more on that later.

Figure 1 and Table 1 describe the tripole's dimensions, and in each case the *finished/trimmed* length I ended up with is given, along with the calculated values and the lengths I would advise you to start out with. The column heading abbreviations represent the following: CHW is the Calculated Half Wavelength (468/frequency in MHz). This is mostly useful to determine the overall length of the antenna, and whether or not you have the space to fit it into your yard! It is never really used for anything as a cutting dimension. The way I put this one up, you need only 1.414 times the CQW length, or a lot about 90 feet wide, to have it fit. If you determine from my figures that you have the room, skip right to the CQW, the Calculated Quarter Wavelength, which is either CHW/2, or you can calculate it directly by using 234 divided by frequency in MHz. These formulas allow you to adjust this antenna for different frequencies within these bands, or even build the antenna for other

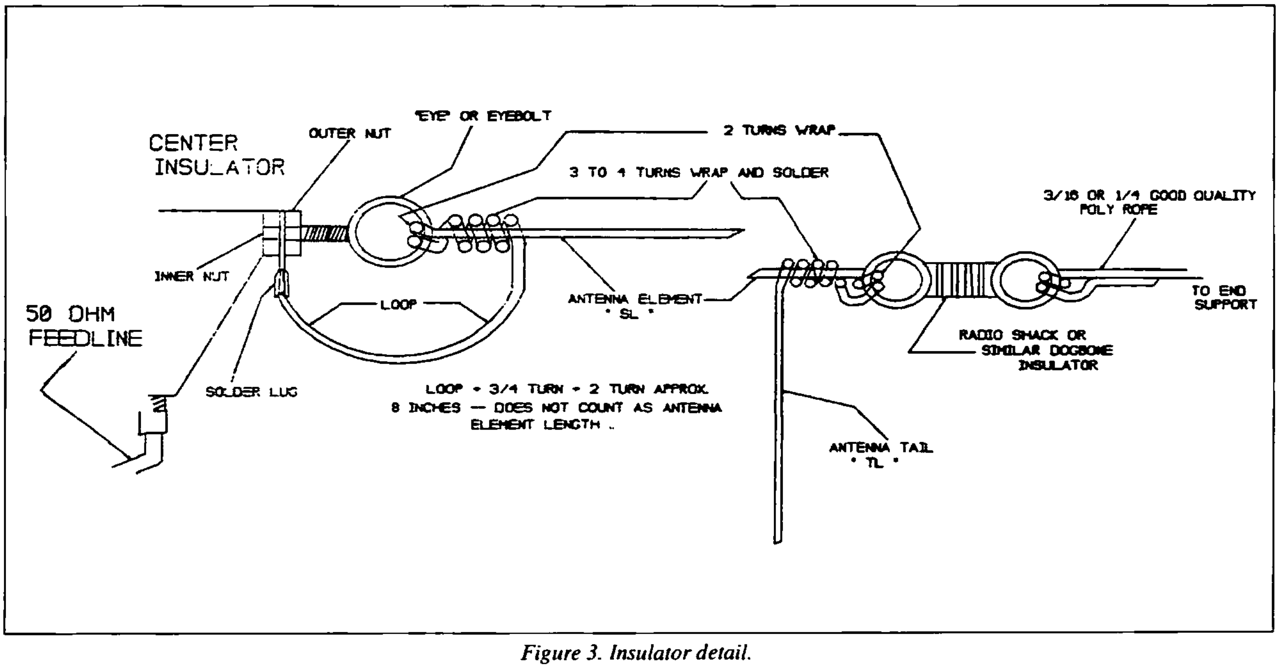


Figure 3. Insulator detail.

bands. The dimensions shown are for the following: the 80m design centers frequency = 3.840 MHz; the 40m design centers frequency = 7.150 MHz; the 30M design centers frequency = 10.100 MHz.

Next is the CQW again, just expressed in more useful feet and inches. SL refers to starting length, TL refers to "tail" length, and FT was the final amount I trimmed from *my* antenna. I emphasize *my*, because I want you to have enough left in the tails to trim to suit your particular antenna, building materials, where and how high you put it, and so on. I have tried to leave enough slack to cover all of those things. For more details, see the construction and assembly portion of this article.

Construction and Assembly (CAN Be Fun!)

Figure 1 was drawn with the three dipoles laid out flat (side-by-side) for clarity of the dimensions of each part. In reality and in assembly, the three antennas end up in a "cage" triangle arrangement that gives the antenna a much more mechanically stable look. I can't say if it really buys you anything from a windload standpoint, or if it is really more solid mechanically in that configuration than if you left it all flat, but it just plain looks better. After all, aesthetics and neighborhood appeal should count for something, right?

Yes, I have built it both ways, and the *only* difference I noted was the more pleasing look of the cage assembly, and that the flat version seemed to blow around more in the wind. The only difference in assembly is the number of spacers you have to use (less for the flat version, of course, by about 40 spacers) and when and where to put them. While on the subject of spacers, this antenna is for HF use, and there are many suitable materials you could use. I had many hundreds of gray plastic spacers that had been ribbon cable hold-downs in some type of cable TV distribution system. Plastic clothspins of all kinds work well for spacers at HF. Most work, but the best look was achieved by a friend who "duplicated" (what *real* ham ever "duplicates?) my antenna. He made his spacers out of 1/8" plexiglas material available in most hardware and plastic outlets. He started by sawing out squares 4.5" on a side. Then he sawed them to make triangles, and drilled holes to pass the antenna wire through in three places. See Figure 2 for the details. Besides more work, the only plus this buys you is just one insulator every 12 to 15 inches, instead of three . . . your option. It does make an antenna with a nice "see-through" appearance, I must say.

Figure 1 shows the layout and dimensions in accordance with the abbreviations used in Table 1. It is much easier to see what things like "tails" are in this type of drawing. One thing you must remember, if you are new at antenna building, is to leave enough wire to do wraps and solder area and the like. For that reason, I'll walk you through the 80m dipole, which you construct first. Starting with a length of wire at least 65 feet long, pass the wire through the eye of the center insulator and fold it over at about the 8" length. Use the 8" length to make two wraps around and through the eye for added strength, and the three-to-four turns tightly and smoothly around the longer wire (see Figure 3). Use a large iron or soldering gun to solder this connection, and then bring the 6" or so that should be left down in a smooth loop to reach the solder lug for that side of the center insulator. You can go ahead and solder that now, or leave it until you have all three antennas to this point. I prefer to go ahead, as the lug will probably only hold one wire anyway (built for single antennas), and you will have to wrap the other two antennas around the small loop and solder later.

Incidentally, that small loop in no way represents any of the actual antenna length! If you will notice, it is one big short from the solder lug to the eye you looped through, so the "antenna" effect is minimal at best. Do not use the loop length as part of any of the calculated antenna length.

Now, from the loop through the eyebolt, measure out the length given as SL, and mark this point (I suggest a black-ink permanent marker), then add TL, plus about 2" or so that it will loop through whatever you use as an end insulator. Don't be afraid to leave this too long—this is just like pruning legs on a milking stool. You can cut off—you can't cut on!

Just be sure the SL length is correct and double (triple) check it now, before you do anything else at the end insulator of this wire. Feed *all* the insulators of whichever type you choose to use onto the wire. Spacing is not an issue at this point, just get them all on, and double and triple check that the number present is correct! For my individual insulator construction, this is 44 insulators per side, about two every 15" as you work out from the center until you reach 36 total, and then eight more at the same 15" interval heading toward the end insulator. Now, feed the wire through the end insulator in a loop so that when the wires touch again, it is exactly at the SL marking. Make three to four turns around the main wire just like at the center insulator end, and solder thoroughly, bringing the tail away from the main antenna section at a right (90 degree) angle. The tail should be very close to 18" or slightly more. If so, you have done well. My beginning piece of wire for this segment (1/2 of the 80m dipole) was 62'10" (8" center—60'6" antenna—2" end insulator—18" tail), but I have been doing this for 30+ years! Like I said, don't be afraid to cut things long. Just be sure those SL lengths are right on—that is the antenna element!

You can now put the center insulator carefully in a vise, or tie it down to a solid object and use side one to make side two. That is another good reason for double and triple checking the first half you did. When you complete that, you have an 80m dipole—with a lot of plastic hanging on it! I like the idea of clamping the center insulator into the vise, so that I can bring the two end insulators out parallel and close to each other (a foot or so apart at the end insulator ends. This allows you to use something like a sawhorse at the end insulator ends to pull the wire out fairly taut. They must be straight and fairly close to perform the next steps.

Next Floor—Going Up, Please!

Adding the 40m elements is the next step. Again, start by measuring off two lengths of wire in the same manner as the 80m dipole. This should be something close to 34'3" (or more!)—8" + 32' 2" + 2" + 15". You can now do the center insulator connections just like you did the 80m connections using that 8" extra wire, and go ahead and do both sides. While the wire is out of the insulators and you can still accurately measure it. Start at the eye of the center insulator once again, only this time go out 32'2" on each wire and use the black marker to mark those points. Now comes the only tricky part, and all it requires is that you think ahead and don't hurry. Start with either side element, and feed the loose end through the open hole in insulator #1, one hanging from the 80m element. Skip insulator #2, hanging from the 80m dipole, and feed on the first of 18 new insulators that you will add to this 40m element. Next you go through #3 hanging from the 80m, skip #4, and add a new one from the "18" pile. Continue this "do one, skip one, add one" until you get out past the 36th of 44 insulators hanging from the 80m dipole—18 you went through, every other one (18) you skipped—and you added 18 from the pile. You can now continue on through *every* insulator (8 more) hanging from the 80m dipole, just as you would any multi-element dipole. You might want to use masking tape as I did to set these 15" intervals and keep things neat as you go.

As the 40m element goes through the last insulator, you should check that that point is right at the 32'2" mark. If all is correct, bend the remaining wire away from the 40m and 80m elements at a right angle, and tape that point as well. Repeat the process on the other 80m element with the other 40m element addition. You should now have a combination 80m/40m dipole combination, quite useable as is. I chose to add the 30m, as well, since my other antenna is a Cushcraft R-5 Vertical, and it only covers 20m through 10m.

At Last—The Last . . .

Adding the last band is simple, but you must take your time and get all the spacers right where you want them. This gets complicated because, as you thread the 30m element through the spacers (all there now, none to add), there will also be a "space" the width of one spacer *between* each of the spacers you thread through on one side. Otherwise you would cause the whole thing to bunch up. My easiest way turned out to be just do the center

insulator work first for both sides—same instructions as the 80m and 40m—and then start feeding the loose end of the element through first the "skipped" #2 insulator on the 80m element, then through the first insulator on the 40m element, then the #4 insulator on the 80m element, then the second insulator on the 40m element, and so on until you have gone through 36 insulators. *Then* go back and space everything out nice and neat, and temporarily tape with the masking tape. You will be trying to make a nice and neat little triangle out of the three elements, keeping the wires each about the spacer hole-to-hole distance apart from one another. This forms a nice little cage about 3" on a side in my antenna, for the length of the 30m element, and then the simple 3" spaced pair out to the end of the 40m element, and of course the single wire on out to the end insulator of the 80m element. When all the spacing is nice and neat, I suggest you apply small amounts of epoxy glue (five-minute variety worked fine for me) to each side of the insulator hole where the wires pass through to keep the insulator "set" at the 15" position. You could use tape or RTV type glues if you want the ability to go back and change things as I did in the first two models. Now I have the final dimensions, you can feel safe "nailing-it-down" with more permanent gluing methods.

Some general information may be of interest. Not only did I want this antenna to serve the needs created by my new license; I also wanted an antenna that could be easily duplicated just about anywhere, so a lot of the parts ended up being from mail order in *73* magazine (so I *know* you can get them also), or from my friendly neighborhood Radio Shack store. I have no less than four of the latter on my way home, depending on the routes I take, and I keep all of them busy (and puzzled) a lot. The wire I used is from Radio Shack, and is seven strands, twisted copper, about 14 gauge, and is RS part #264-1312. The center insulator I obtained by mail order from Cable X-perts, and it is 1:1 direct connect (no balun). The insulators I explained, but you can use the plastic clothspin idea just as well—just keep the spacing at about 3". In fact, a quite colorful (kinda mod and neat) one was built this way with the "see-through" plastic clothspins of various colors arranged symetrically working, out from center. The end insulators have been either the quite common dogbone plastic variety from Radio Shack (RS part #278-1336), some teflon ones I bought at Dayton some time ago, or even the 1/8" plexiglas I mentioned earlier in the triangle insulators. I *do not* recommend the last one and mention it only because it is tempting if you are going to use the clear plexiglas for the rest of the insulators. The stress at the ends, due to the antenna weight, seems to be able to "knaw" through this type of insulator every time when used this way. It is worth the small cost to go the Radio Shack direction.

Up, Up, and Away!

The only additional tip I can offer is this: Be very careful when installing antennas. Stay away from power lines—*period*! Not only will they detune *any* antenna put near them, they can do a real mean number on *you!* By the way, *you do not* have to actually *touch* them! That is a myth. Should you be unfortunate enough to be around the higher voltage distributions that come right through neighborhoods along with the lower house feed systems, you have not only have *bare* wires to deal with, you also have considerable *fields* out from those wires. Remember your basic electronics: Pass current through a wire (in this case, the high-voltage line) and bring another wire (your antenna) close to it—and you get *induced* voltage, folks.

My antenna was put up as follows, for those who want a carbon copy of my results. The apex (center insulator) is 86 feet from the hamshack, in a due-east direction. From there, the two legs of the antenna go out to the compass points of 45 and 135 degrees (about to the NE and SE), meaning there is a 90 degree apex angle much like an inverted "V." The big exception is, the legs go straight out, not down, from the apex point. I seem to have the desired and expected E-W coverage, and yet the antenna is *not* running directly N-S as you

Continued on page 79

73 Review

Number 10 on your Feedback card

by Gordon West WB6NOA

Heil, Ltd.
2 Heil Drive
Marissa IL 62257
Telephone: (618) 295-3000
Price Class: ProSet $135.95 w/adapter cable
Pro 5 $119.95 w/adapter cable

The Heil Headsets with Boom Microphone

Listen to these quality featherlight units.

Last summer at Field Day a 20 meter station was using a Hell Pro Set headphones and microphone assembly that looked inviting to try on. When it was my turn at the rig, I went for the Heil headset to give it a try and couldn't believe how comfortable it was.

The first thing you notice while putting on the headset is how extremely lightweight it is. Unlike older headsets that would cramp your ears and weight your head and neck, the dual-earpiece headset weighs only 10 ounces, and the single-earpiece headset weighs seven ounces. Ultra-lightweight!

The headset earpieces are cushioned with a material that feels like foam and is covered with a micro-thin supple black vinyl. The vinyl has little grooves in it to allow air to circulate around the cushion, cutting down on sweat. But when you put the earpiece on, it effectively blocks out any extraneous noise.

The single- and double-earpiece headsets have a lightweight Heil microphone boom set that can be adjusted close to your mouth. Inside the plastic noise-canceling microphone pick-up enclosure is an element developed especially for maximum clarity on SSB. We looked at the response of this element on a scope, and it drops off quickly under 375 Hz as well as above 3000 Hz. The natural peak of the boom set microphone was around 2.4 kHz, for excellent articulation in the normal speech range. You can easily hear the difference between a Heil element on the air versus typical traditional microphone elements found in the mikes that accompany most HF and VHF sets.

The flexible boom mike terminates to the left earpiece. For some reason, I always use a microphone coming in from the right side of my face. There is no provision to change this, so get used to the mike coming in from the left! It took me all of about 10 minutes to accomplish this.

Whether you order the single earpiece or double earpiece Heil headset with boom mike, they come with a plug assembly that is common to the headset with a mono or stereo one-quarter-inch phone plug and a miniature phone plug. Both of these plugs go into a color-coded six-inch pigtail assembly that matches the microphone input for the following rigs:

Blue for ICOM
Yellow for Yaesu
Red for Kenwood
Red for most Alinco
Black for Ten Tec
White for Collins
Others by special request

Good news—you don't need to drag out that miniature soldering iron to play around with sub-miniature wires onto micro-miniature contacts on a microphone plug. The mike plug pigtail simply inserts into your favorite HF or VHF/UHF transceiver, and the boom set plugs into the pigtail. But wait—where's the PTT? The push-to-talk switch is a lightweight but heavy-duty foot switch that goes on the floor for a convenient method of controlling your station. The heavy-duty foot switch we tested has a non-skid rubber pad, complete with a seven-inch cable that plugs into the pigtail. If you don't like the foot switch, you can order up the HS-1 hand switch which, is similar to those air traffic controllers use. Both allow hands-free operation, and both switches terminate into a one-quarter-inch phone plug that interfaces to both the Heil boom set and the microphone.

"At first we came out with the double-earpiece headset, but by popular demand from those operators wishing only a single-earpiece headset, we now offer the Pro 5, which is identical to the double-earpiece headset," comments Bob Heil K9EID. "Here at Heil Sound, we believe in human-engineering all of our microphone systems to the requirements of the radio operators—so whether they want one ear covered or both, we have it!" adds Heil.

If you have several different radios, you can use the headset between them with additional pigtail connectors. Each cable is about $22.

The professional quality boom sets for amateur radio, including one color-coded pigtail for your particular style transceiver, sells for around $135. A descriptive catalogue showing all of the different combinations of the headsets is available by writing Heil, Ltd., 2 Heil Drive, Marissa, Illinois 62257; (618) 295-3000.

You might also ask for details on the Heil ham radio handbook that I feel is one of the best $10 values for the new amateur operator learning all about the hobby. It's a fun and descriptive book, written by Heil. It's the best I've seen.

Photo A. This headset felt comfortable even after several hours of Field Day testing.

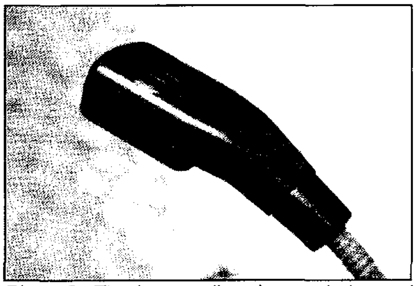


Photo B. The boom mike element is housed in a noise-cancelling enclosure.

HAMSATS

Number 11 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

The AMSAT Annual Meeting

The 1994 AMSAT Annual Meeting and Space Symposium was held October 7-9 in Orlando, Florida. Over 200 satellite enthusiasts listened to dozens of presentations, visited the Phase 3D integration facility and made satellite contacts using an impressive antenna array set up outside the convention hotel. For all participants, it was a fantastic weekend.

Friday

The paper presentations began Friday afternoon with updates on the Shuttle Amateur Radio EXperiment (SAREX) by Frank Bauer KA3HDO, John Nickel WD5EEV, and the program's Principal Investigator Lou McFadin W5DID. SAREX did very well in 1994 with increased random contacts and many fine scheduled contacts with schools from the ham-astronauts. Joan Freeman KD4SRD presented a SAREX case study describing how her school prepared for and operated during their contact with Bob Cabana KC5VBH on the *Columbia* Orbiter during STS-65.

Dennis Wingo KD4ETA provided an update on the *SEDSAT* program. *SEDSAT-1* is a microsat-class satellite that will be flying as a secondary payload as part of NASA's Small Expendable Deployer System (SEDS). Changes in launch schedules have caused delays with this hamsat. *SEDSAT* will carry several scientific and amateur-radio experiments. The main purpose of the satellite is to test the dynamics of tethered satellites and remote sensing. Dennis also presented ideas on a *SEDSAT*-class, amateur-radio satellite to be placed in lunar orbit.

Dan Schultz N8FGV delighted the audience with his pictures from the Hubble Space Telescope. Dan showed several images representing photos before and after the shuttle repair mission, a few of which were included as handouts for those attending.

AMSAT Director Bob Diersing N5AHD told the story of *DOVE*'s recovery. The process to bring *DOVE-OSCAR-17* back online and make the satellite talk has been long and hard. Many volunteers have been involved in the process since launch. Bob also outlined plans for *DOVE*'s future to include easier recovery from problems and more speech transmissions from the spacecraft. Efforts are underway to allow the satellite to transmit telemetry values using voice.

Last year David Liberman XE1TU could not present his paper on the UNAMSAT microsat project from Mexico. He was feverishly preparing for launch. Due to many delays with the Russian commercial/military launcher program, UNAMSAT is still not in orbit. This year David was able to talk to the symposium and describe UNAMSAT's proposed operation, what to expect and how to use the data once the satellite is in orbit. With an extra year to refine the satellite, David and his group in Mexico have been able to further study and test the complete system on the ground. The meteor scatter experiment, using a low-VHF transmitter/receiver, has worked extremely well and should provide excellent results in orbit for meteor ionization trail propagation studies by both students and amateur radio operators.

Philip Chien KC4YER finished the day's talks with a quick look at launch opportunities beyond Phase 3D. Philip pointed out the difficulty amateurs will have in the future finding rides to orbit. He noted that the amateur community should be ready to go on short notice when a launch opportunity becomes available. Many potential rides have already been missed.

Saturday

Activities began in earnest at 8 a.m. when AMSAT President Bill Tynan W3XO gave an official welcome to the symposium participants and introduced the symposium Chairman Al Brinkerhoff WB5PMR. Al has been an active satellite chaser for many years and coordinated an AMSAT meeting and space symposium in Dallas several years ago. He and his crew of volunteers did an incredible job in Orlando. Registration was easy, the prizes after the banquet were great and the communications bus from Florida Power and Light provided an excellent mast for the satellite antennas used by the symposium satellite station.

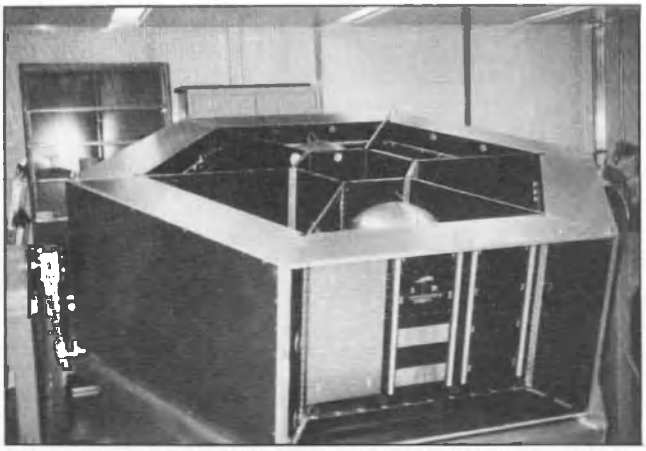


Photo A. The Phase 3D assembly is currently under construction in a special clean room at the Orlando International Airport Foreign Trade Zone. Tours of the facility were part of the symposium.

Professor Robert Twiggs of Stanford University gave the first talk of the day. Bob's presentation paralleled the symposium paper by Christopher Kitts and Richard Lu on the Stanford SQUIRT Micro Satellite Program. SQUIRT stands for Satellite Quick Research Testbed and represents an opportunity to prepare and launch educational payloads designed to operate within the parameters of the amateur radio satellite service. The first SQUIRT is to be called *SAPPHIRE* for Stanford Audio Phonic Photographic Infrared Experiment. It will be hexagonal in shape, nine inches tall, 16 inches in diameter and weigh roughly 25 pounds.

Peter Guelzow DB2OS gave two presentations on Saturday. His first was based on the paper "The Re-Entry of *OSCAR-13*" by James Miller G3RUH. Due to the pull of the moon and sun, AMSAT-OSCAR-13 is expected to re-enter the atmosphere and crash to earth in late 1996. James' guess is December 5, 1996. Peter's second paper was presented later in the day. It covered the Controller Area Network, or CAN, that will be used for digital communications between subsystems onboard Phase 3D.

AMSAT President Emeritus Dr. Tom Clark W3IWI described his Global Positioning System (GPS) experiment for Phase 3D. He titled the talk "Where Am I and What Time Is It?" Through the use of multiple GPS receivers on Phase 3D, Tom proposes to not only define the exact position of the spacecraft at any instant, but also to preserve extremely accurate time on the craft, maintain a set of orbital elements for transmission with the telemetry, and to accurately define the orientation of the craft with relation to the sun and earth. It's an ambitious project, but other groups around the world are showing interest in Tom's proposed uses and other possible ramifications of having such satellite data available.

Walter Daniel KE3HP followed Tom with a presentation on the use of star cameras for satellite attitude determination. Doug Loughmiller KO5I/GØSYX came after Walter with his description of the small satellite programs at the University of Surrey in England. Doug is a past president of AMSAT-NA and a long-time hamsat enthusiast. His presentation was well received. Later in the day he spoke on the AMSAT-UK contributions to the Phase 3D program.

Photo B. AMSAT Executive Vice President Keith Baker KB1SF with the massive Phase 3D space frame in the clean room.

Photo C. Antennas and other satellite hardware were on display in the integration facility for symposium participants

Photo D. AMSAT Vice President of Engineering Dick Jansson WD4FAB and Jan King W3GEY with the burst-tested fuel tank in the integration facility.

The morning talks concluded with an update on the TAPR/AMSAT DSP-93 Project. The Tucson Amateur Packet Radio, Inc. group and AMSAT agreed a few years ago to jointly fund a program to design and eventually market kits using Digital Signal Processing (DSP) to make a new modem based on software that could be connected to a standard Terminal Node Controller (TNC). The result is the DSP-93. The first production kits were out in November. The second round are scheduled for release in early March, and at least 100 should be available from TAPR and AMSAT at the Dayton Hamvention in April. The initial offering included software for 1200 baud AFSK (standard VHF packet), 300 baud AFSK (standard HF packet), 1200 baud PSK (for use with microsats), 9600 baud FSK for both terrestrial and full-duplex satellite operation, and a number of audio filters. Several other software efforts are underway for release in early to late 1995 including APT for weather satellites, a digital oscilloscope, SSTV (slow-scan television) and other HF modes.

The afternoon topics proved to be a very detailed and intense session on the current status and future efforts regarding the Phase 3D program. Phase 3D promises to be the most versatile and expensive hamsat yet. The international coordination needed to bring it all together is phenomenal. AMSAT President Bill Tynan W3XO provided opening remarks describing Phase 3D as a new era for amateur satellites.

Dick Jansson WD4FAB presented the latest findings and engineering studies on the mechanical and thermal design. Stan Wood WA4NFY showed the antenna designs and locations on the space frame for antennas covering VHF, UHF and microwave bands. Peter Guelzow DB2OS described material from Dr. Karl Meinzer DJ4ZC of AMSAT-DL on the RF subsystems and attitude control. Lyle Johnson WA7GXD talked about the computer for satellite housekeeping and a new digital communications experiment to be incorporated into the craft. Other topics covered during the afternoon session included the Phase 3D propulsion system by AMSAT Director Dick Daniels W4PUJ, more on GPS by Tom Clark W3IWI and his crew and, finally, concluding remarks from Steve Park WB9OEP, who did a great job keeping the presentation schedule running smoothly.

Following a short break to allow everyone to catch their breath and relax after data input overload, the yearly banquet began. The speaker was Dr. Paul Shuch N6TX. His light but informative topic was "The Search for Dark Matter." Paul has that unique ability to make the most complex topic both understandable and fun. Prizes and AMSAT awards finished the evening. The prizes ranged from books and maps to S-band gear from SSB Electronics and an ICOM 281H mobile transceiver.

Photo E. Joan Freeman KD4SRD presented a SAREX case study on how she got involved in the Shuttle Amateur Radio Experiment program with students in her school

Sunday

Following the Field Operations breakfast at 7 a.m., the talks began again with topics devoted to operating via the hamsats. Keith Baker KB1SF started the forum with advice for beginners. Paul Shuch N6TX continued with a talk on orbital slight of hand and Ed Krome KA9LNV discussed feed system alternatives for mode "S" (2.4 GHz) reception.

Photo F. An operational hamsat station was set up at the Holiday Inn for interested symposium participants to operate.

Gould Smith WA4SXM described activity via the Russian RS satellites. Ned Sterns AA7A explained how the K7TR Field Day group won the 1994 AMSAT Field Day competition. Roy Welch presented Information on AMSAT software and John Hansen WAØPTV reported on software for the digital birds.

During the sessions, special buses were available to take symposium participants to the Phase 3D integration lab at the Orlando International Airport Foreign Trade Zone. The integration team had set up several displays of the satellite systems, the space frame in its clean room and various experiments to demonstrate GPS, satellite attitude control, and antenna efforts. At the same time, the AMSAT Board of Directors meeting began.

Bill Tynan coordinated the board meeting, which lasted through mid-Monday with a few breaks for food and sleep. The agenda covered many items, Including publications, SAREX, the DSP project status, long-range planning, commercial relationships, new satellites and the budget. AMSAT has a significant challenge ahead to pay its part of Phase 3D and still maintain its many other activities. Work on fund raising will continue to dominate AMSAT's operations until the launch. Discussions were also started on AMSAT's future beyond Phase 3D. Although many attending the Board of Directors' meeting may have found the conversation more like a philosophy session, it got everyone thinking: Where do we go from here? What's next?

Orlando, Florida, may be the site again for the 1995 meeting; an announcement is expected soon. It is sure to be a fascinating event since Phase 3-D will be near completion and just about ready for launch.

Copies of the Proceedings of the symposium are available from AMSAT or the ARRL. The book is 8-1/2" by 11", 154 pages, and softbound. It's well worth the cover price of $12. AMSAT can be contacted at 1-213-589-6062 for details on shipping charges.

Straight Key Night

For many years the ARRL has sponsored Straight Key Night (SKN) on New Year's Eve and New Year's Day. In 1972 a group of satellite chasers decided to try their hand at some straight key CW via *OSCAR-6* during SKN. The idea caught on and the tradition has been maintained whenever there has been a satellite available for the event.

AMSAT Vice President of International Affairs Ray Soifer W2RS Invites interested satellite operators to participate in the 23rd annual SKN via OSCAR. He reports that there are no rules, no scoring, and no need to send in a log. Just call CQ SKN in the CW passband segment of an OSCAR between 0000 and 2359 UTC on January 1, 1995, or answer a CQ SKN call from another station. Contacts via the moon also count. Nominations for best "fist" can be sent to W2RS @ WA2SNA.NJ.USA.NA via packet or to W2RS@AMSAT.ORG via the Internet. You can also use his callbook address ■

Photo G. The Orlando symposium crew provided an impressive support for the satellite antennas. (K1MON photo.)

RTTY LOOP

Number 12 on your Feedback card

Amateur Radio Teletype

Mark I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

With the customary greetings, let me be among those of your old friends to wish you a happy and healthy new year. In this changing world, may 1995 be a year of peace and prosperity for you and yours. Now, to the business at hand. A dip into the mailbag this month.

Jim Hale KJ5TF of Kingston, AR, sends along a note which relates that he would "like to try RTTY, but I hear that I may find it difficult with low power.

"My home is in the backwoods and power poles are about $30,000 away. We have built up our solar and battery system over the years and are quite happy this way.

"My old batteries are retired telephone cells and I don't like to run more than 30 watts. My Ten-Tec Argo only has a maximum power of 50 watts.

'What band is the most interesting for RTTY and PACTOR?

"If I built a two- or three-element delta loop beam on that band, would my low power be okay? I have wire loops in the trees all around the house, and they work very well versus dipoles. I could aim one east, and another west.

"I don't want to spend a lot on a controller. What are some 'older' modems I could use with my 386 laptop?"

Well, Jim, these are some very wide-ranging questions. The photo on your QSL card looks idyllic. but I see your problem! First off, my congratulations on being able to supply your own power away from the commercial grid. That alone might be the subject of another article. Don't worry, though, as with other amateur modes, communication on RTTY is as much a factor of technique as anything else.

If you can hit a local packet repeater, commonly called a digipeater, that might be your best entry point. Monitor some of the common frequencies, such as 145.01 or 145.03 MHz, for the distinctive "brrrp" of digital communications.

Now, on HF, given your Argo, I would suggest two options. Listen around 3620 kHz for RTTY signals, and try to answer a CQ you can hear well. The other popular venue for RTTY is 20 meters, with 14.080 MHz being the center of the street. Once again, depending on how well you can hear signals, communication should well be possible.

As far as modems go. you have at least two choices. You could try to obtain an older modem, such as the HAL ST-5 or ST-6, iRL, or Flesher units, and use a terminal program such as those discussed in recent months, and available in the "RTTY Loop" collections. Alternatively, there are small, dedicated controllers that work with programs such as Baycom or PMP. Again, scan the ads here in *73* and the programs in the collection.

Overall, don't let these obstacles stand in your way any more than your distance from the power lines did. Good luck, and let us hear about your success!

Some want to get on, others want to get off. Let me share these two letters with you, as well:

Sheldon Daitch WA4MZZ, Box 182, Louisville, GA 30434-0182, writes of his large assortment of Model 28 TTY and Northern Radio manuals that he will pass along to interested RTTY buffs for the cost of postage. He says that he's carried these manuals around for several moves, and now wants to put them in a good home, rather than toss them. I don't know what he still has, as of this publication date, but it's worth a stamp if you're interested.

On the other hand, Joe Brugman WB6ALI, of Whittier, CA, wrote with some follow-up of his search for takers of equipment last year. After mentioning the availability of the mechanical teleprinters, no one exactly beat his shack door down. Then, he got an idea that maybe one of the movie prop rental houses would like to have it. After all, he does live near enough to Hollywood! Anyway, after some calling around, he located a company that accepted the material, presumably to use as a prop in some future production. Joe looks forward to tuning in one day and seeing his legacy being tuned on!

With movie and other theatrical productions taking place all over these days, even Baltimore has seen productions from the movie "Avalon" to the weekly TV show "Homicide" being produced here. This is another place to investigate when you move off the green keys to the green screen, so to speak.

Eric WA8ZJY sent along a question via AOL, in which he refers to a comment regarding possible modifications to the Hal DS 3000 to allow for output to a printer. He is also interested in any other modifications that may be available for this device. Having used it in conjunction with a Model 28, he would like to put the mechanical teleprinter aside and use a more power- and noise-efficient printer or file storage such as a PC. Anyone using the DS 3000 in this way, we all would appreciate hearing from you.

Another AOL fan is David Laustsen N3LHY, of Doylestown, PA. David writes that he has a Mac Centris 650 running system 7, with a PK232MBX used on RTTY, AMTOR and PACTOR. He has the AEA software MacRatt with FAX. Having gone round and round with AEA, David can't get the program to work on this new Mac. It worked OK on the old "toaster" Mac. He has friends who have had the same problems and have either gone to a dumb terminal program (as he has for now) or sold the 232 and gone with the KAM. Enough background. The question is: Is there any software out there for the Mac family that will run on System 7 and do a decent job of controlling a 232 on the HF modes?

Well, you might look around on America Online's Ham Radio SIG (go ham radio). There is a library of Apple programs, and while I can't say for sure that there is a program in that library for you, it may be your best first show. Again, I look forward to hearing from you.

All these folks are dropping me Email online, and you want to get in on the fun? Write me via America Online (MarcWA3AJR), Internet (MarcWA3AJR@aol.com), CompuServe (75036,2501), or Delphi (Marc WA3AJR). Sure, snailmail to the above address is OK, too! All seven of the RTTY Loop disks remain available. Drop me a line for the listings and details. For now, that's a wrap, and we'll see you next month here, in "RTTY Loop."

Number 13 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church, VA 22041

Problems Running Your Ham Radio MS-DOS Software On That Snazzy New Windows Machine? Here's a Solution

There's an awful lot of software available for ham radio and general electronic hobbiest use, and much of it is written for MS-DOS machines. Normally, MS-DOS software runs fine on Windows machines, but sometimes you will see an error pop up that reads something to the effect of "Out of Memory Error" (or something similar—I've seen a couple variants). The error might occur on INSTALL, or when attempting to run the program.

When I saw that while trying to load one of my wife's MIDI musical notation programs on my new 486 machine, I about had a fit: "Whadya mean, 'Out of Memory'? I've got 16 whopping megabytes!" Unfortunately, the DOS core of my 486 machine still thinks it's in a 640K world. When I ran CHKDSK, the report on the screen showed that there was not enough memory left in my lower 640K to run, or even install, the program.

The problem is that memory in the lower 640K gets chewed up as you add features to the computer. Mine has a mouse, a CD-ROM drive, and a few software packages that all take up a little space in the lower 640K. As the Windows computer becomes more sophisticated, the more likely it is to go "tilt" when attempting to install a new MS-DOS program.

Fortunately, there's a workaround that should keep the software up and running until the S/W maker decides to release a Windows version. A call to the musical notation program people revealed the trick. The idea is to create new CONFIG.SYS and AUTOEXEC.BAT files that can run the MS-DOS software without destroying the old files. When you wish to run the odd software, you use a little program to swap the two files (and after you are finished, swap 'em back!).

Before you do anything, however, save the CONFIG.SYS file in a "golden" (which means you don't touch it) file. Go to the DOS prompt (C:\) and type:

```
COPY CONFIG.SYS CONFIG.SAV
```

Next, save the CONFIG.SYS file to a new file, which you will modify. My wife's music program wants to use CONFIG.MPP, so I'll just ape them (you can make up a name to fit the name of the software you'll be running).

```
COPY CONFIG.SYS CONFIG.MPP
```

You can check the CONFIG.SYS or its clone CONFIG.MPP file by using EDLIN or any word processor that will read ASCII DOS text (which is about all of them). From the DOS prompt, type:

```
EDIT CONFIG.MPP
```

Or, use your word processor software to find the same file in the root directory (C:\CONFIG.MPP). For my machine, the CONFIG.SYS and unmodified CONFIG.MPP file looks like this:

```
LASTDRIVE=Z
DEVICE=C:\DOS\SETVER.EXE
FILES=40
DEVICE=C:\SB16\DRV\SBCD.SYS
/D:MSCD001 /P:220
DEVICE=C:\SB16\DRV\CSP.SYS
/P:220
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\ANSI.SYS
DOS=HIGH
STACKS=9,256
BUFFERS=10,0
SHELL=C:\DOS\COMMAND.COM
C:\DOS\ /p
DEVICE=C:\DEV\MTMCDAE.SYS
/D:MSCD002 /P:300 /A:0 /M:20
/T:5 /I:10
```

The manual for the software ought to say something about the minimum CONFIG.SYS file needed to run the software. For the program that I was installing for my wife, the desired CONFIG.SYS should have read something like:

```
FILES=20
DEVICE=C:\DOS\ANSI.SYS
BUFFERS=20
```

They also told me that I should leave in any line that looked anything like:

```
SHELL=C:\DOS\COMMAND.COM
C:\DOS\ /p
```

The next step was to cut out anything in CONFIG.MPP (copied from CONFIG.SYS) that isn't needed. If the FILES and BUFFERS statement has a higher number than 20, then leave it (it is a minimum number). My final version of CONFIG.MPP looked like:

```
FILES=40
DEVICE=C:\DOS\ANSI.SYS
BUFFERS=20
SHELL=C:\DOS\COMMAND.COM
C:\DOS\ /p
```

You may also have to alter your AUTOEXEC.BAT file. This file is examined when the computer is booted up, and it determines whether or not any programs need to be run. Go to the DOS prompt (C:\) and type:

```
COPY AUTOEXEC.BAT AUTOEXEC.
SAV
```

and, then:

```
COPY AUTOEXEC.BAT AUTOEXEC.
MPP
```

Next, call up AUTOEXEC.MPP on either EDLIN or the wordprocessor. Mine looked like this:

```
C:\BIN\MSCDEX.EXE /D:MSCD003
/D:MSCD002 /D:MSCD001 /M:10
SET SOUND=C:\SB16
SET BLASTER=A220 I5 D1 H5
P330 T6
REM ** C:\DOS\MSCDEX.EXE
/D:MSCD001 /V /M:15
C:\SB16\SB16SET    /M:220
/VOC:220 /CD:220 /MIDI:220
/LINE:220
/TREBLE:0
C:\SB16\SBCONFIG.EXE /S
C:\DOS\SMARTDRV.EXE
ROMPT SPSG
PATH C:\DOS;C:\EXCELL;C:\EX-
CEL;C:\WINDOWS;C:\WP51\;C:\W
INWORD
REM***MOUSEWARE 6.10 SETUP***
PATH  C:\DOS;C:\EXCEL;C:\
MOUSE;%PATH%;C:\WINWORD
SET GMKW5=C:\WORDPERFECT
MOUSE CENHANCE SER 2
REM ************************
SET TEMP=C:\DOS
```

For now, you may not have to do anything, but if the new MS-DOS program fails to run, then you'll need to start removing some things (from AUTOEXEX.MPP, not, repeat *not*, AUTOEXEC.BAT or AUTOEXEC.MPP!).

You also need to create two new batch files: SETMPP.BAT swaps CON-

FIG.MPP to CONFIG.SYS, while SETNORM.BAT swaps CONFIG.SAV (which was the original CONFIG.SYS file, if you will recall). These can be created on your wordprocessor software, and then stored as ASCII (DOS TEXT) in the root directory. The routine to make CONFIG.MPP the active CONFIG.SYS is:

```
C:
CD
COPY config.mpp config.sys
COPY autoexec.mpp
autoexec.bat
ECHO {{PROGRAM NAME}} Configuration READY!
ECHO Please reboot computer:
Press CTRL/ALT/DEL
PAUSE
```

The line {{PROGRAM NAME}} should be replaced with the name of the program you want to run, or something that lets you know what was done. Once done, save this line as SETMPP.BAT in ASCII/DOS TEXT.

The function of this simple program is to copy the .MPP version of the configuration file to CONFIG.SYS, and the AUTOEXEC.MPP to AUTOEXEC.BAT.

Next, you need to write the program that will replace the old CONFIG.SYS file back in place (remember, this is now called CONFIG.SAV). Write the following using the wordprocessor:

```
C:
CD
COPY config.sav config.sys
COPY autoexec.sav
autoexec.bat
ECHO Regular Configuration
READY
ECHO Please Reboot Computer:
Press CTRL\ALT\DEL
PAUSE
```

And save this program as SETNORM.BAT (again, save it in ASCII/DOS TEXT). The purpose of this program is to undo what the other program did. This configuration makes the computer think it's your Windows machine again.

Next, reboot your computer, and get to the DOS prompt (C:\>). Rebooting can be done by simultaneously pressing the CTRL/ALT/DEL keys. After all the turn on verbiage passes, type:

```
SETMPP
```

And then press <ENTER>.

The program will swap the .MPP versions into CONFIG.SYS and AUTOEXEC.BAT. Now you can try to install the new MS-DOS program. If the new program installs and runs, then no further adjustment is needed. However, if you still get the Out of Memory error, then (from DOS prompt) type:

```
SETNORM
```

Press <ENTER> and reboot the computer (CTRL/ALT/DEL). Get to your wordprocessor, and call up AUTOEXEC.MPP. Edit it to remove unwanted items. Start eliminating anything that isn't a Prompt, Path or Mouse line. I removed each item in turn until the INSTALL program ran. After each deletion, save the AUTOEXEC.MPP file and try again: From DOS prompt run SETMPP and reboot. If the program installs, you are home free. Otherwise, go back and try eliminating other lines from AUTOEXEC.MPP.

Remember, each time that you need to run the MS-DOS software that tilts your machine with an Out of Memory Error, you will have to run SETMPP from the DOS prompt (NOT from the Windows DOS prompt—Exit Windows if your machine automatically starts Windows on turn/on) and then reboot by pressing CTRL/ALT/DEL. When you finish using the MS-DOS software, then you will have to run SETNORM and then reboot (CTRL/ALT/DEL) to restore the original configuration file.

Conclusion

This solution to the problem is workable (although I wish that the software writers would write Windows versions of their productl). Someone with more computer smarts than me can probably give us a better solution (I'd like to hear from you, if you do). However, it does work. Since the MusicPrinter Plus help line people pointed out this solution in their user's manual (which I should've read), I've used it for a filter design program that will soon be reviewed in this column, and for the software the accompanies a distance learning course in economics that I am taking. Readers can reach me at P.O. Box 1099, Falls Church, VA, 22041.

QRP

Number 17 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

A new year brings new projects. This month I have some small projects to make those long winter nights more enjoyable.

MFJ Modification

The first project is a modification to the MFJ QRP transceivers. I've run several modifications to these rigs before, but this one looks like a real winner. As you might expect, it deals with the lackluster audio some of the early production models had. As usual, I've not had the time to install any of the following modifications. So, if you don't know what you're doing, by all means don't mess up the insides of your rig!

The modification shown in Figure 1 for the MFJ rigs comes from KB4ZGC. Most of the work centers on the addition of an audio preamplifier to the input of the LM386. Notice the volume control inserted between the product detector and the audio preamplifier. Also note, the LM386 is operating from the unregulated power side while the preamplifier is running from the 10.5+ regulated supply.

As a side note, I've been informed that MFJ is so far behind, as I write this, that there may be a wait for the rigs. Depending on what model you want, I've been told up to eight weeks' wait is possible. MFJ suggests contacting one of their larger dealers, as they will be getting their orders done first.

NorCal 40 Modification

The NorCal 40 has been an extremely popular little 40 meter rig. The NorCal 40 is tuned by a pot controlling a varactor diode. It's a nice way of tuning the rig, but deep down inside most of us, we want a variable capacitor. Figure 2 shows a circuit to replace the varactor diode with a capacitor. I think you'll find this circuit will work just fine in place of the varactor diode/pot. It's also great to have laying around in your files, too. The 40-40 uses the same type of tuning method as the NorCal 40 and you may be able to use this circuit, too.

Buck-Boost Regulator

OK, here's a strange one: How many times have you built a rig and then needed to add on a power supply? If you're like me and want to run the critter from a battery, there's usually a problem: The popular three-terminal voltage regulator ICs fall out of regulation when approaching their operating voltage. You can use one of the low-dropout regulators, but you're still limited to the voltage set by the regulator.

While working on another off-the-wall project, I came upon a slick circuit from Linear Technology (see Figure 3). It's known as a buck-boost regulator. Its input is from 8 volts to 40 volts. The output is set for 5 volts, but can easily be changed to 12 volts. The regulator will supply up to 5 amps of current. That's more than enough for us low-power freaks.

The converter is based on the Linear Technology LT1074 switching regulator IC. This device needs only a few external parts to make up a complete regulator, including thermal protection and current limiting. This design uses off-the-shelf parts for low cost, and easy availability of components. The LT1074 is available from Digi-Key.

Here's how it works: At intervals of 10 microseconds (100 kHz) the control portion of the LT1074 turns on the switch transistor between the Vin and Vsw points, impressing a voltage across the inductor, L1. This causes current to build up in the inductor, while also supplying current to the load and capacitor C1.

The control circuit determines when to turn off the switch during the 10 ms interval to keep the output voltage at the desired set point. When the switching transistor turns off, the magnetic field in the inductor collapses and the polarity of the voltage across the inductor changes to try and maintain the current in the inductor. This current in the inductor is now directed (due to the change in voltage polarity across the inductor) by diode D1, to the load. The current will flow from the inductor until the switch turns on again (continuous operation), or until the inductor runs out of energy (discontinuous operation). The divider circuit consisting of R1 and R2 is used to set the output voltage of the supply against an internal voltage reference of 2.21 VDC. Resistor R3 and capacitor C3 make up the frequency compensation network used to stabilize the feedback loop.

I plan on building up one of these regulators, but I have not had the time as yet. It's a simple circuit, as you can see. I feel this circuit has some merit in QRP. Many of the power FET amplifiers require a power supply of at least 24 volts. This switching regulator may be used to supply a second regulated voltage to the receiver, or low level transmit stages—all without the excess heat normally generated by a linear regulator.

My only concern would be the RF noise generated by the switching at 100 kHz. The high audio gain used in most direct conversion receivers might pick up the switching noise. This should be an interesting avenue to travel.

I would also try to reduce the size of the inductors. A 5 amp inductor is a formidable-sized critter.

That's it for this month. Since we have started a new year, next time we meet, I'll have something very different. After all, the next century is only only five years away.

See Figures 2 and 3 on page 58

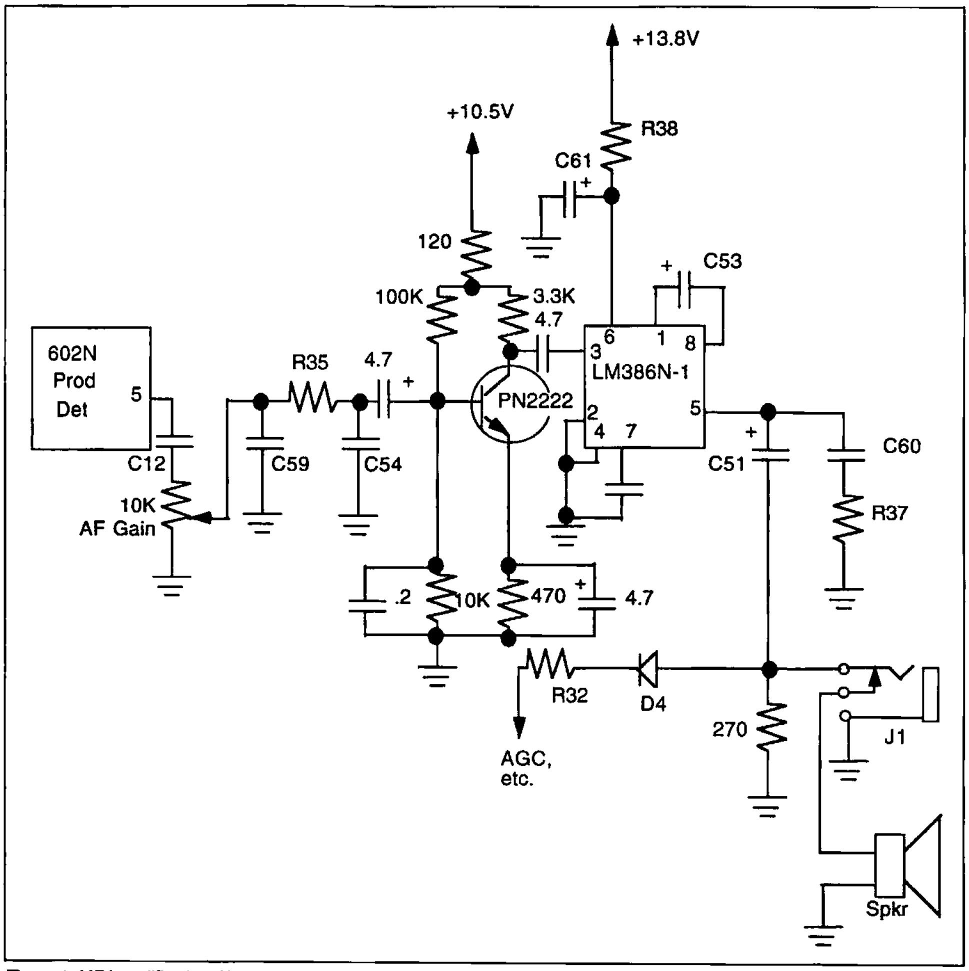


Figure 1. MFJ modification. Note: MFJ wired my 9020 LM-386N-L as shown, with signals fed to non-inverting input, an invitation to positive feedback. It should have been injected on pin 2! I installed AF preamp and changed the AF circuit as shown above. I have sufficient speaker audio, though the 386 is not driven nearly to its specified 250 mW. With no signal, a slight hiss can just be heard with AF gain put at 3 o'clock; very little full CW.

Continued from page 56

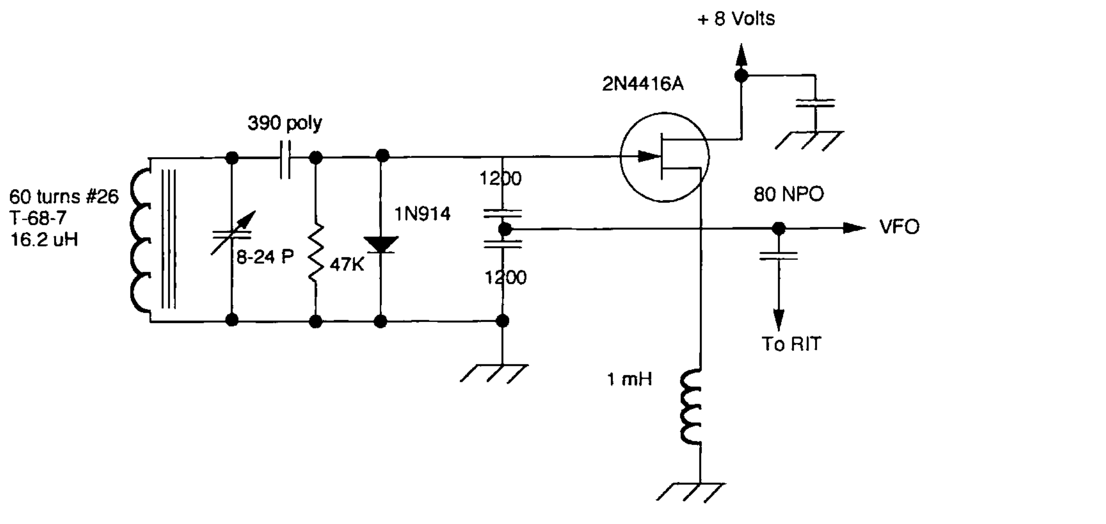
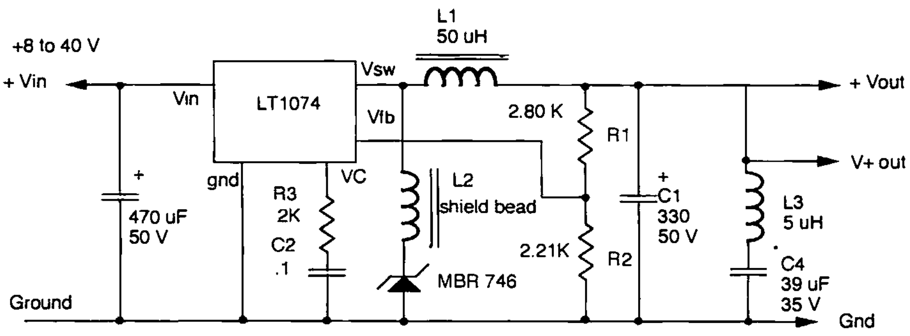


Figure 2. Capacitor-tuned NorCal-40 VFO.



$$+V_{out} = 2.21 \left[1 + \frac{R1}{R2} \right]$$

Figure 3. Buck-boost switching power supply.

Number 18 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Bright Idea for a Trip

One of the most popular trips that the seventh grade students in my school go on is the trip to the Franklin Institute Science Museum in Philadelphia, Pennsylvania. Over a million visitors a year come to this wonderful place where they are encouraged to "please touch" the exhibits. I, of course, have my own favorite spot to send the children to explore: the amateur radio station, W3TKQ.

The first thing the children see when they enter this impressive building on Benjamin Franklin Parkway at 20th Street is the 21-foot, 144-ton marble statue of Ben Franklin. For over 50 years it has sat there; immense, powerful, a symbol of the great American and Philadelphian who was a publisher, inventor, and statesman for the early United States two centuries ago.

The children always come back with terrific stories about their day at the Institute, and how they had so much fun at the radio station. The ham volunteers who are at the station are usually pleasantly surprised when a group of youngsters from my ham radio classes come through. It's generally an exciting experience for all.

This past summer I was visiting some friends in Philadelphia, and decided to extend the weekend and visit W3TKQ. My two very gracious hosts were Merrill KT3Z and Bill KA3ZHB. It's amazing how there is always "instant comaradarie" when hams meet. My friend Roger W2SLP and I were given a tour of the facility and had a chance to spend time speaking with museum visitors at the amateur radio station.

An entire wall of the exhibit is dedicated to displaying radio equipment from as early as 1918. With the help of Mrs. Gioia Marconi Braga, the inventor's daughter, the Phil-Mont Mobile Radio Club put together an exhibit which contains a set of pictures that describe Marconi and his achievements in a story fashion. There are 42 photographs that clearly show the development of Marconi's inventions. The Phil-Mont Radio Club has exclusive rights to show a video feature about Marconi called "The Spark That Shook The World."


Photo A. Carole WB2MGP with Merrill KT3Z at W3TKQ


Photo B. Carole WB2MGP and Roger W2SLP at the mike; Bill KA3ZHB speaking to visitors.

This exciting exhibit has been in operation since 1952. It has been sponsored since 1962 by The Phil-Mont Mobile Radio Club, Inc. The recently remodeled station has been seen by more than 120,000 visitors since it was formally rededicated on October 23, 1991, by Marconi's daughter. There are seven console positions. Members of the Phil-Mont Club were asked to donate at least $15 each. Each console was marked for dedication by any person who would donate $500 for that station. In less than a month, all consoles had been "sold."

The seven positions consist of:

1. Dedicated 2 meter intercom for the club's local repeater, plus Kenwood 144 MHz and 220 MHz.
2. IBM computer and MFJ TNC running Alinco 1200 dedicated NTS system for visitors and locals.
3. Satellite tracking station: ICOM 970 and Tandy computer running "Quick Track" and "Kansas City Tracker" programs.
4. Kenwood 950 with PK232, TL922, monitor scope and Rupp SWR/power meter to a Mosley PR067 10-40m beam.
5. Guest operating position: Kenwood TS450, computer and KAM all-mode TNC for HF/VHF packet.
6. Ten-Tec Omni VI with tuner to a Cushcraft R7 antenna.
7. ATV: WR450 transceiver, local monitors, 2m intercom, video output terminal and tripod-mounted camera.

When I spoke with the club president, Ed Masarsky KB3IV, he praised the work of the volunteers who man the station seven days a week. Volunteers are not necessarily all members of the Phil-Mont Radio Club. They are all dedicated and do a terrific job interacting with the public, according to Ed. Ed also explained that the visit to W3TKQ is very often someone's first exposure to amateur radio. From what I observed, myself, when I was there, all the visitors were greeted by enthusiastic, knowledgable volunteers.

It's easy to see why the youngsters have such a positive experience at the station. If you live in the vicinity of a museum or science institute, try to get your local clubs to sponsor a radio station for the benefit of the community, especially the children.

If you plan to take a class or large group to the Franklin Institute, it would be wise to call the ARS ahead of time to make sure that the volunteers will be ready for the group at a specific time. Call (215) 448-1139.

Note: I'm still looking for youngsters for the Dayton '95 Youth Forum. Please have interested children call me at (718) 983-1416 for an interview.

Number 19 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Up and Running with GPS

"What's the bearing?" Many times an hour, that's my demand to the helpers as I drive on hidden transmitter hunts (sometimes called foxhunts or T-hunts). It is important to know the latest indication from our radio direction finding (RDF) equipment. We don't want to be caught off guard by a sudden change in signal direction as we close in or as the road meanders.

In unfamiliar areas, my second most frequent request is, "Where are we, anyway?" When there are no familiar landmarks, that question may not be easy to answer, especially at night. Fortunately, there is now an inexpensive method to determine one's exact location anywhere on planet earth: The Global Positioning System (GPS).

The GPS constellation of 21 orbiting satellites provides high accuracy UHF timing signals that are used by inexpensive specialized receiver/processors to compute your location. Most GPS receivers also perform navigation functions such as computing headings and distances to destinations or waypoints of your choice.

"Homing In" for October 1994 explained how navigation systems such as GPS came about. This month, let's take a closer look at the latest GPS equipment and methods for integrating it into automated signal tracking networks.

It's Affordable Now

Typical of early models of all new technologies, the first GPS receiver/computers were quite expensive. Commercial mariners bought them, but their prices were beyond most pleasure boaters and hikers. Hams who wanted to extract GPS position and course data for applications such as Automatic Packet Reporting System (APRS) found that bare-bones GPS receiver cards for the original equipment manufacturing (OEM) market were the only way to buy GPS capability without shelling out over a thousand bucks.

Selling for about $450, the Magellan OEM 5000 is a 3.5" x 7" GPS receiver card that operates from a 12-volt source. It puts out 4800 bps serial data at user-selectable intervals, but it has no display or enclosure. A similar unit, called the Basic Encore, is made by Motorola.

As competition and manufacturing efficiency have increased, prices of full-function receiver/processors have dived into the pocketbook range of weekend sailors and T-hunters. For most applications, a hand-held GPS display is now more economical than a receiver card. Just make sure that the set you choose has a serial data output for connection to your computer and RDF system. (Look for "NMEA-0183 interface" in the specifications.)

Last spring, the Garmin GPS-50 hand-held GPS broke the $400 barrier, and marine dealers' shelves were quickly cleared. Garmin continues to add features to new models in its line, keeping prices in the $400 to $500 range. Now, the Meridian GPS Satellite Navigator from Magellan Systems Corporation costs less and is the top contender for most popular choice among T-hunters (Photo A). It has a detachable antenna that can be separated from the receiver by up to six feet, so you can put it on your car roof. It outputs your choice of three NMEA-0183 data streams.

Discount marine stores carry the Meridian for less than $380. Its internal three-AA-cell supply lasts for about five hours (much less if you use the backlight at night). You can get an external power kit for $80 to connect it to the vehicle's 12-volt system. This kit also includes a quick-release mounting bracket and antenna extension cable.

Photo A. I used a cellular phone swivel mount to attach the Magellan GPS bracket to the overhead console in the van to put it at eye level. A four-foot length of RG-58 cable connects it to the rooftop antenna.

Several T-hunters here are experimenting with Meridian GPS units. Mine gives solid indications with an external antenna. Its navigation features were second-nature to use after about a week of practice during my commute. My only gripe is that the liquid crystal display has a highly polished window. As you can see from the photo, it is nearly impossible to find a mounting position that does not give some glare in the daytime. That can make it hard to read, despite its good-contrast 3/8-inch-high numbers.

Will GPS receiver prices drop even more? Well, improved parts are making them much less expensive to manufacture. For example, a new integrated circuit from GEC Plessey in England puts all the active circuits for converting GPS information in its incoming spread-spectrum form into the final IF stage into one chip. But many think that receiver consumer prices will remain at present levels because sales are brisk.

Someday this may change, due to competition from alternate positioning services. *Electronics World And Wireless World Magazine* reports that Inmarsat, an international satellite operator, has announced the inclusion of navigation transponders on its next generation of satellites. The system will feature signals to correct the deliberate errors introduced into Navstar GPS. Position fix accuracy will be within 10 meters, 10 times better than civilian units at present. Launches are planned to begin in late 1995.

An Automatic Pin In the Map

A GPS receiver displays your exact latitude and longitude in degrees and fractional minutes. Those numbers by themselves mean nothing to most of us landlubbers. We tend to think in terms of distance and direction with respect to familiar landmarks, instead

Photo B. The APRS power-height-gain display plots the radio horizon around each station. Notice the small circle of the mobiles (car symbol), the larger circles of the base stations (house symbol), and even larger green ones for digipeaters (green stars on the screen). Any two stations with intersecting circles can communicate directly. (All screen photos are by WB4APR.)

Photo C. APRS triangulation display of intersecting RDF beam bearings transmitted by packet from base stations. The location of this fox was within a half mile of the intersection of the bearings. Most were taken 15 to 20 miles away. Any APRS user in radio range can call up this display, including mobile T-hunters.

If you enter your favorite landmarks as waypoints in the GPS set's processor, it will display your distance and bearing to them, along with your present direction of travel and speed. That's helpful, particularly for finding your way home at the end of a transmitter hunt. But what most of us want is an easy-to-read indication of our exact position on a map of some kind. Automakers are developing navigation systems like this for cars of the future, but they are still pricey.

T-hunters are inventing a number of ways to get the same kind of map display, using portable computers with serial ports connected to the NMEA data port of their GPS sets. In the September 1994 issue of *73 Amateur Radio Today*, "Homing In" described a computerized bearing display by software engineer Robert Barris KD6IFZ. Since then, Robert has added a Meridian GPS to his system. He wrote a program to use GPS serial data to pinpoint his vehicle's exact position on the complete Orange County street map that he has digitized and stored in compressed form on the hard drive in his Macintosh PowerBook.

When the coordinates come into the computer's RS-422 port from the GPS, his program analyzes them, calls up the appropriate map segment and draws it on the screen around his position point in the exact center. As he drives, the map moves under his position point to update his location.

"The new program translates your GPS location onto the map very accurately, usually within five houses on the street," Robert says. "It allows us to concentrate on driving and bearing-taking for a while, then look down and very quickly see where we are without having to unfold the map and flash a light over it.

"I added a feature that lets the GPS display communicate with the RDF program, so they run together in a multitasking fashion," he continues. "We can see the true beam bearing (the bearing relative to the car plus the true car heading) as long as we're moving. That has some limitations, because GPS only gives accurate headings when in motion. I put a threshold in the software so that when the car's velocity goes below 10 kilometers per hour, the beam heading disappears from the screen.

"We've used it on three hunts now, and the experience has been uniformly positive, especially when we are in unfamiliar areas. We can drive around instinctively for a few minutes making random turns here and there and then say, 'This isn't paying off, where are we and which way do we have to go?' Then we can look at the computer map and there we are."

Robert has not yet fully integrated the mapping program with the RDF bearing display program for real-time plotting, but he is planning on doing that soon. "It has great promise for our first-finder-wins RACES T-hunts because of the ability to take a very accurate bearing while moving," he adds. "On the freeway at 55 MPH, it could lay down successive bearings as you move along, so you get an idea of where the T is before you pass the right exit."

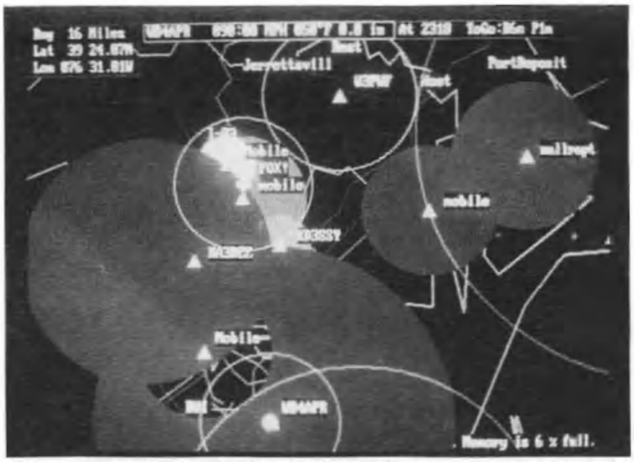


Photo D. APRS plots overlapping signal strength contours of reports from stations with omnidirectional antennas. The large (violet on the actual screen) circles show negative reports. Chances are, the hidden transmitter is not in those regions. Brighter, smaller circles in shades of blue on the screen show places where the fox signal is heard with various strengths.

Every Road in the Country

Another local hunter is using a commercial map data base program to navigate electronically. To do it, Eric Nansen N6YKE installed a PC and CD-ROM drive in his vehicle, along with a GPS receiver.

DeLorme Publishing Company produces two domestic atlas data-base

Photo E. The APRS fade circle technique computes the likely location of an unknown signal from three locations of equal signal strength. A mobile DF station with an omnidirectional antenna drives to three places where the fox signal fades out. APRS computes where a fox should be to give these fade-out points.

products on CD. Street Atlas USA version 2.0, which retails for about $170, has detailed digital road maps of the entire USA. Eric says he has used it on "All Day" T-hunts where he ended up in the middle of the California desert. He found that the digital map included many out-of-the-way jeep trails that were not on his paper maps. One reason for this is that DeLorme solicits its users to send in new road information to be incorporated in updates of both its paper and electronic maps.

The PC program requires at least a 386 running Windows 3.1 with 2 MB RAM and a mouse. There is also a Macintosh version. You can view streets and addresses with Street Atlas, but if you want to interface with GPS, you must move up to another program, Map Expert. It has the same internal atlas, but also accepts NMEA GPS data into any serial port in the computer to plot your position.

Map Expert allows you to create and save your own overlay files to add landmarks, buildings, and new roads to your map screens. Unfortunately, the overlays cannot include moving data, such as a real-time RDF indication. Eric is writing an add-on program to do this. He says that his biggest problem so far has been keeping the mobile CD-ROM drive functional while four-wheeling in the desert.

PC requirements for Map Expert are the same as for Street Atlas, but there is no Macintosh version. Retail price is $495, but it is available directly from DeLorme for $295 plus shipping and handling.

Economical Tracking With APRS

As I described three months ago, the APRS program by Bob Bruninga WB4APR is an economical alternative for GPS mapping. You don't need a CD-ROM, a large hard drive, or Windows. You can track yourself and others on VHF T-hunts using just a low-end PC laptop with a floppy and serial input for the GPS data (8086/640K/CGA or better, color preferred). APRS.EXE size is only about 300K and maps average about 15K each.

Of course, you cannot put super-detailed maps in 15K files. There is no room to store every twist and turn of every road or to hold residential street names. But if you have the disk space, you can have over a hundred map files available for automatic selection by the program as you move about.

APRS makes up for its lack of detail by incorporating a myriad of networking features unavailable elsewhere. APRS stations can use packet to map one another's positions. They can also exchange messages and data on packet, including RDF bearings.

[Editor's note: We regret that we cannot print these photos in color.] Photo B shows a typical network of APRS stations transferring packet data via unconnected (UI) frames. APRS will plot the radio range of all stations. Users instantly see potential paths for direct connection and digipeaters available for relay. Stations not sending specific values for power, antenna height, and gain in their automatic position report are given the default of 10 watts, 20 feet, and 3 dB omnidirectional antenna gain.

With another user command, APRS displays the triangulation solution for RDF stations reporting their beam bearings (Photo C). In an APRS network, everyone sees the triangulation almost instantaneously. Reporting stations assign a quality rating to their

Continued on page 67

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Space Camp Adventure

One of the advantages of living in the rocket city (Huntsville, Alabama) is the proximity of the U.S. Space Camp facility. Located at the U.S. Space and Rocket Center, Space Camp (and Space Academy) offers a variety of programs. Participants from fourth grade through adult glide through astronaut training and shuttle mission simulation. Organizers have taken an interest in demonstrating amateur radio as part of their program and are currently constructing a complete amateur radio station at the site.

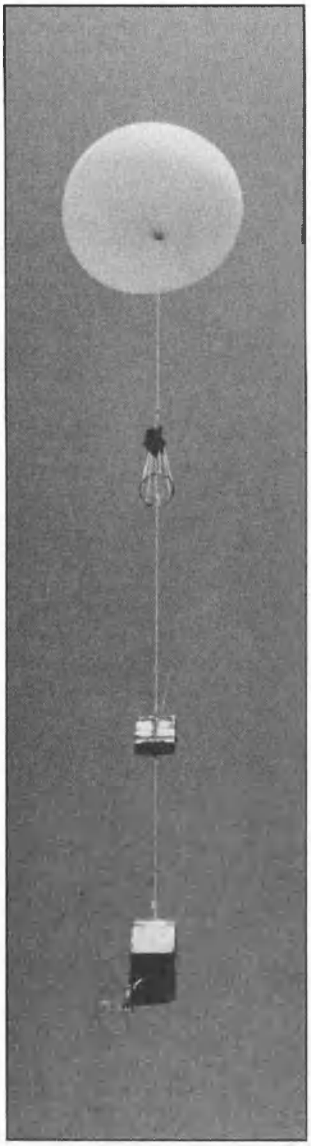


Photo A: The Space Camp balloon heads for the stratosphere after skirting past a Saturn rocket. The balloon system consisted of a simplex repeater on 2m and an ATV transmitter with a live color camera suspended on the bottom. (Photo by Jim Skala WA8VWY.)

To celebrate the 25th anniversary of the first moon landing, I offered to fly an ATV balloon from Space Camp to demonstrate that amateur radio could simulate the launch of a weather and communications satellite. They were excited by the idea and asked me to fly the payload as part of their International Space Camp session that included selected students from 23 countries and the teacher of the year from each U.S. state. The local chapter of the National Space Society, HAL5, agreed to co-sponsor the event and the flight preparations began in earnest.

The Payload

Using components from a number of previous flights, I put together a 5-watt ATV transmitter on 434 MHz, complete with a color camera. The exciter was a Mini-TV postage-stamp-sized transmitter (ATVM-70) feeding a PA5 power module (SAU4 brick), available from PC. Electronics, 2522 Paxson Lane, Arcadia, CA 91007; tel. (818) 447-4565. The PA5 module is capable of 10 watts or more, but by backing the exciter power down a bit, I was able to achieve around 5 watts output with a current drain of around 1.5 amps. The current drain was critical since anything more than this would put a strain on my lithium cell pack. The color camera (model HA4500) is lightweight and compact and has a built-in electronic auto-iris. It's available from Howard Enterprises, Inc., 545 Calle San Pablo, Camarillo, CA 93012; tel. (805) 383-7444. The antenna was an omnidirectional horizontal "Little Wheel" available from Olde Antenna Lab; tel. (303) 798-5926; mounted on a dowel rod about 18 inches below the styrofoam package. The whole system was powered by five D-cell lithium batteries (15 volts @ 7.5 Ah).

A separate package was constructed to simulate the communications satellite. It consisted of an ICOM 2AT and a digital voice storage circuit that operated as a simplex repeater. It would record whatever it heard for eight seconds and retransmit it in a continuous cycle on 144.34 MHz. This proved to be a very simple and effective way to build a repeater without having to worry about desense problems. It just took a little practice to get used to the delay when using the repeater.

The Flight

Although the morning of July 31st started out overcast, the weather started clearing up as the ground station was assembled and the payload was prepped for launch. We were situated in Rocket Park, behind the U.S. Space and Rocket Center, literally surrounded by rockets of all shapes and sizes. Thanks to the efforts of Gene Marcus W3PM, Ed Stluka W4QAU, and others of the Huntsville Amateur Radio Association (HARA) and the HAL5 branch of the NSS, an impressive ground station was wired up next to a Lunar Module in the center of the park.

As the balloon was inflated, Space Camp participants assembled around the launch site to watch the activities. We slowly reeled out the balloon. I held onto the ATV payload and finally got my chance to say, "That's one small step for a man, one giant leap for a balloon!" I released the payload and the balloon skirted past a towering Saturn I rocket on its way to the edge of space. The downlinked video was spectacular, providing us with an impressive aerial view of the rockets surrounding the park.

As the flight progressed, a constant stream of intrigued onlookers glued themselves to the TV screen while they watched the city of Huntsville get smaller and smaller as the balloon gained altitude. Live views from the balloon could even be seen on a wide-screen TV in the Center's cafeteria.

A hour and a half into the flight, the payload was over 115,000 feet high and the blackness of space and the curvature of the earth could be seen in full color, with a P5, signal at the launch site. Tom WA8ZAH in Cincinnati reported a nearly P5 picture from 300 miles north of Huntsville, while Dick W8RVH (New Carlisle, Ohio) and Mark KA9SZX (Champaign, Illinois) saw a P3 picture at a distance of nearly 370 miles.

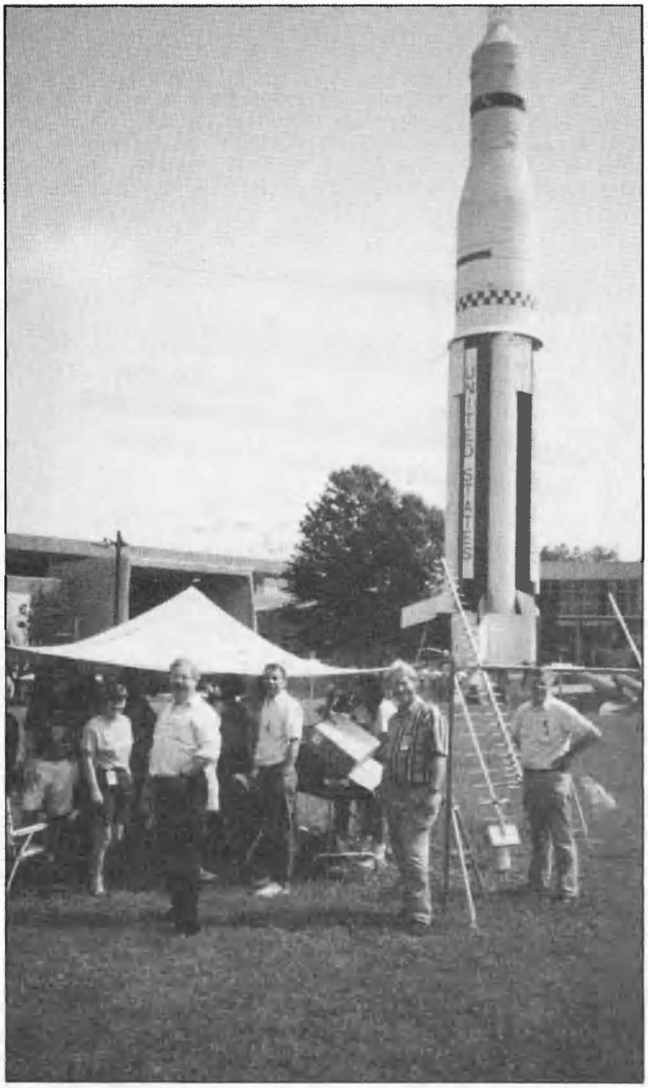


Photo B: Members of the Huntsville Amateur Radio Association and the HAL5 chapter of the NSS operate the ground station in the middle of Rocket Park at the U.S. Space and Rocket Center.

The simplex repeater on 2m worked great, with stations contacting each other over a large portion of the Midwest and Southeast. At least one contact covered a distance of over 500 miles between Ralph N4NEQ (Marietta, Georgia) and Joe KEØFF in Rolla, Missouri. Unfortunately, a screw worked loose inside the HT and shorted out the frequency-select line towards the end of the flight, causing the transmitter to shift up 22 kHz. Only a few stations were able to work through the repeater after that, due to the oddball shift.

The Recovery

Since we were having so much fun at the Space Camp ground station, most of the chase crew didn't leave to track down the balloon until long after it had burst and was nearly on the ground. It appeared that the payload would land in the hills of Tennessee (about 40 miles north of Huntsville) and it looked like it was going to be a difficult recovery. Fortunately, John Fox WB2LLB and Barry N4MSJ were able to record a clear, nearly snow-free image from the payload almost to the point of hitting the ground. The video sequence clearly showed that the payload had landed on a farm in the middle of a valley. A great place to land, but whose farm had it fallen on? Based on a few beam headings, we searched fruitlessly for the rest of the day around the Fayetteville, Tennessee, area but found no trace of the payload.

Disappointed, but not yet defeated, we returned to WB2LLB's QTH to view the landing video to see if we could figure out its location. The video was nearly P5 until about 500 feet before the payload hit the ground. There were plenty of landmarks: farm buildings, a river and a highway. There had to be a way to figure out the location with this kind of information!

Dick Curtis KK4HF and Barry Lankford N4MSJ found the solution. The next day they took a camcorder and a small TV set to the county courthouse nearest the estimated landing site and showed the video to the tax assessor. The tax assessor's clerk immediately recognized the buildings and said, "That's the McGee chicken houses!" Sure enough, after an hour of romping around the McGee farm, the payload was found in the middle of his cow pasture!

I think Dick Curtis summed up the flight nicely during his evening TV news broadcast, "From near space to the back forty, all in one day!"

HOMING IN

Continued from page 65

RDF reports. The highest quality bearings are displayed as continuous yellow lines, while lesser quality bearings show up as dashed lines.

Sometimes there are not enough base or mobile stations with directional antennas in range of the RDF target to get bearings for triangulation. Bob has added a mode to APRS to help in such situations, taking advantage of the power-height-gain data from non-directional receiving installations.

Photo D is the omni-RDF display, showing the overlapping signal strength contours from stations reporting only strength of the fox, not direction. Violet filled-in circles are null reports where stations do not hear the fox. They give very important data on where the fox is not. Bright blue circles are fox-heard reports.

The reports on this screen were manually entered as RDF objects, since they were voice reports taken from mobiles not participating on the mobile foxhunt. But such reports could also have been relayed automatically via packet. When interpreting the display, remember to look at the edges of the circles and not be misled by the centers. In this case, the mobile fox was right at the edge of one "not-heard" circle.

If a mobile has no RDF antenna, or wants to hunt covertly without one, that user has an additional option for getting a bearing on the RDF target (Photo E). He or she drives away from the general hunt area in several directions and presses the F5 key each time the signal fades out. APRS then computes the circle passing through these points, generates bearing lines and plots their intersection. The fox should be near the center of this circle.

The display does not show a circle because the computation is actually done using straight connecting lines and virtual bearings normal to these lines. The fade-out bearing technique can be repeated closer to the fox by inserting attenuation and finding three new fade points, repeating as necessary.

Bob continues to add new APRS RDF features and applications faster than I can test them. When he told me about the latest version (v6.0), he said, "You can now create a square, circle, or triangle in latitude/longitude coordinates and it will be transmitted as a object to everybody's screen. If you draw a boundary area of a foxhunt that way, everybody will see it. A square can be as small as 100 yards or as large as 100 miles. Rescue groups can use it to transmit the area of a search, too."

APRS is shareware, available for download on most online services such as CompuServe's HamNet. If it meets your needs, register your copy to get configuration saving and GPS port interface functions. If you cannot find the latest version, call the Annapolis BBS at (410) 280-2503 to download it. Registered copies on 3.5-inch HD disks are available directly from WB4APR.

Next time, more on APRS applications and a close look at the new Macintosh implementation of APRS. Thanks to KD6IFZ, N6YKE, and WB4APR for providing information and photos for this month's column. If you are experimenting with GPS and computer mapping for RDF, please pass along your ideas and experiences. Write to my California address atop this column, or send electronic mail to me via the Internet (joe-moell@cup.portal.com) or at CompuServe (75236,2165).

Resources In This Article

Magellan Systems Corporation
960 Overland Court
San Dimas CA 91773
(909) 394-5000

DeLorme Publishing Company
966 N. Main
Freeport ME 04032
(207) 865-4171

Bob Bruninga WB4APR
115 Old Farm Ct.
Glen Burnie MD 21060

Number 21 on your Feedback card

HAM HELP

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2" x 11") sheet of paper. You may also upload a listing as E-mail to Sysop to the 73 BBS /Special Events Message Area #11. (2400 baud, 8 data bits, no parity, 1 stop bit. (603) 924-9343). Please indicate if it is for publication. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

NEEDED: Instruction manual for a B&W Model "600" Dip Meter. I will pay for photocopies and postage. Tnx. *Neil Tanner WA4CHQ, P.O. Box 109, Gwynns, VA 23066.*

NEEDED: Service manual/schematics for MOTOROLA Mobile Transceiver, Model T53GKT-1100A. Xmtr type CC3010; S/N J-4336. Primary Power 12V DC. I will pay for copy and postage. Thanks. *John Wora K2KFG, So.-4907 Clifton Pkwy., Hamburg NY 14075-3341.*

WANTED: Functioning XTAL Filter USB/LSB for DRAKE Model TR3 Xcvr. *Bob Bartolotta K1YFE, 95 Rockwood Ave., Ansonia CT 06401.*

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

Switching Power Supplies for Portable Operation

Switching power supplies are somewhat of a mystery to many in our amateur ranks. The secret of operation lies in a black epoxy chip circuit that defies close examination, and as such might remain a mystery. Because we cannot remove the epoxy and examine the chip or circuitry closely, let's take a short detour and cover just what is going on in a switching power supply.

First, why do we need to switch power supplies? Well, the simplest reason is to provide a different voltage level from a source that is not of the proper voltage (lower voltage). Of course, this could be just the reverse of the above: high voltage input and low voltage output. We have all constructed simple power supplies with a string of positive voltage regulators, all connected to a common input for a multiple output bench test supply. This system works well, but each output is usually low current—less than an amp. The operation in this case is to reduce a voltage through a transistor junction which is in series with the input and output of the power supply.

As a result of this series transistor, it is "on" all the time and has to dissipate power in a *linear* function. The overall efficiency of transfer of input to output power is low, being something less than 40% or so, just like your linear amplifier for SSB operation, whose efficiency is low (input power divided by output power equals efficiency). So goes the same with a power supply.

In a lot of functions this is quite acceptable, particularly for lower current systems. To make this point and drive it home, consider that you do not see a "Monster" single chip regulator for your 12-volt solid-state HF station or 10W 2 meter transceiver. You do see a very heavy bulky power transformer at 60 Hz, with a small regulator and a single or several series pass transistors that are connected to a heal sink that is required to dissipate heat generated in the regulation process. A typical 12 volt linear 10 amp power supply weighs in at about 15 pounds.

Now, to avoid a pun, let's switch to a nonlinear power supply, or *switching power supply*. This type of power supply uses quite a few extra components to accomplish this more complex task. In the long and short of it, the switching system performs better. Let's see why by taking a look at a basic circuit in comparison to the linear circuit type. Comparing the circuit in Figures 1 and 2, it is evident that the pass transistor shown in Figure 1 is on all the time. The pass transistor shown in Figure 2 is switched, or has an *on and off* period. This is the switching rate and is controlled by the circuitry in the device and its external control circuitry.

By being *off* part of the time, according to load conditions, a better power management condition exists and as a result the efficiency is about doubled, compared to a linear circuit. Another trade-off is that the switch mode power supply does not require a bulky 60 Hz power transformer. it uses a very high frequency switch frequency, and the transformer can be replaced with a toroidal-type transformer much smaller in size. The weight of a switching power supply for 12 volt output at 10 amps is less than a pound, as opposed to the 15 pounds in a linear supply.

All is not wonderful in a switch-mode power supply. It requires a larger output filter circuit, making the circuitry more complex and costly vs. a linear supply. You might remember back when there were tubes in automobile radios and the power supply for them was controlled by a *vibrator*. I kind of look at this older behemoth as sort of a marriage between switching and linear technology. It was switching of a sort, not pass regulator switching like the TTL equivalent shown in Figure 3, which uses a conventional transformer or toroid core to step up voltage.

I guess I should explain that a vibrator was a mechanical switch with 12 volts on the center contact from the auto battery. When it was turned on, a coil magnetically pulled the armature of the vibrator one way to make contact with one side of a transformer coil. It would then break the magnetic pull and in the released direction make contact with the opposite side of the transformer. The center tap would be ground and the resulting 12 volts, switched from one side to the other of the input transformer coil, would look like switched AC on the primary. Whether done mechanically or electronically, the principle is the same today: An alternating rate is required to

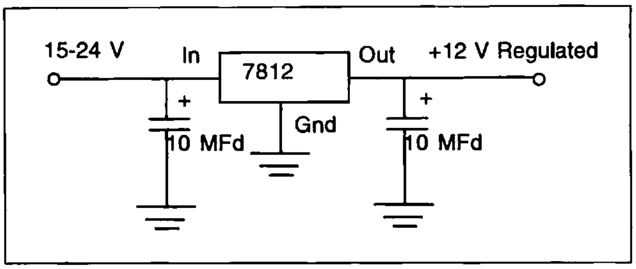


Figure 1. Basic linear regulator (7812, etc., typical).

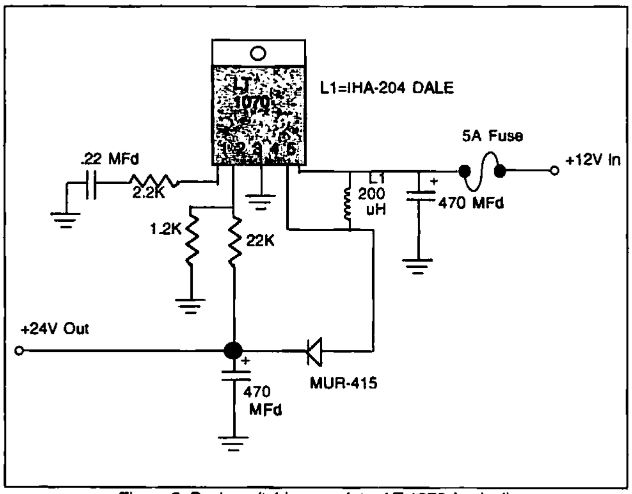


Figure 2. Basic switching regulator LT-1070 (typical).

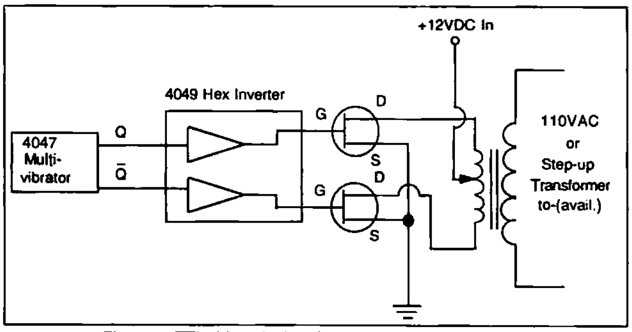


Figure 3. TTL-driven isolated power supply basic design.

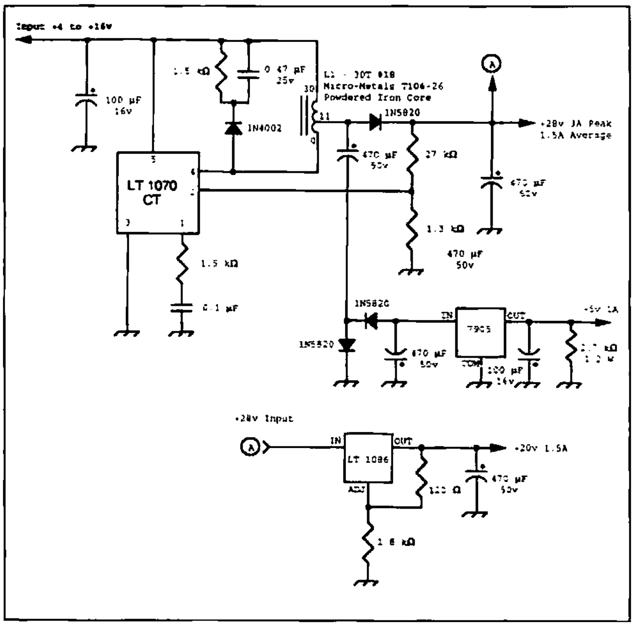


Figure 4. Linear technologies LT-1070 switching regulator, +4 to +16 volts input, +28 and -5 volts output courtesy ol WA6CGR.

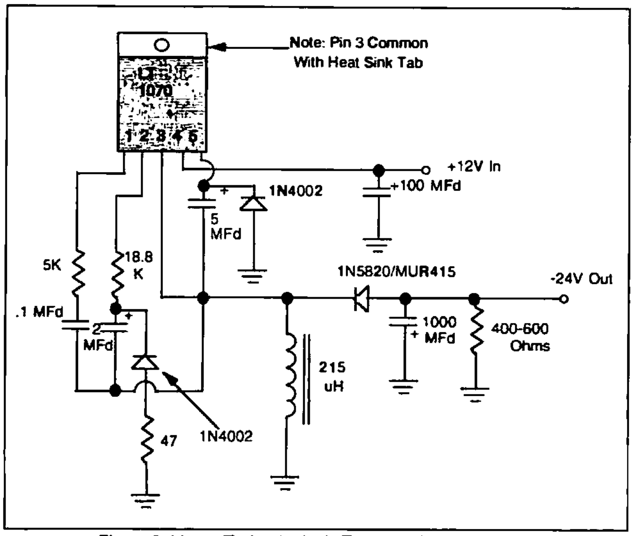


Figure 5. Linear Technologies' LT-1070 polarity inversion.

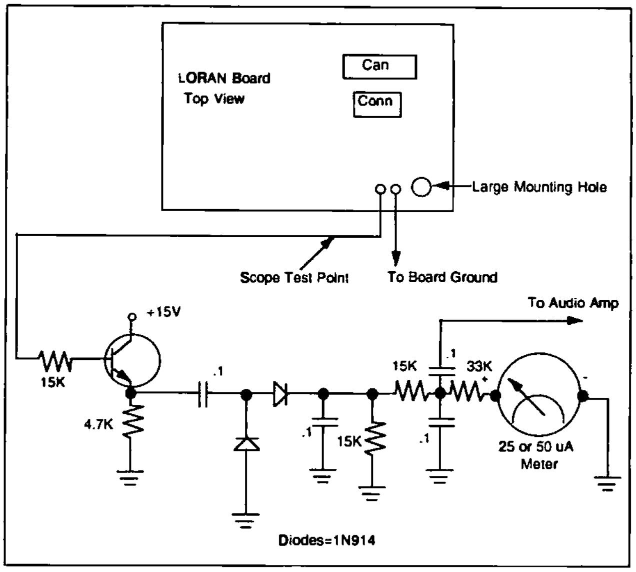


Figure 6. Loran receiver S-meter detector circuit (K9EUI).

Induce current into another winding of a transformer.

Enter the LT-1070, a switching regulator from Linear Technologies. It differs from the TTL-type switching circuit as much as from the mechanical vibrator switching types in that the TTL and vibrator should not be called switching types at all. In fact, the TTL and vibrator examples are linear in all respects. Only the LT-1070 is a true switch mode regulator because it has a on and off period. See Figure 4 for a schematic diagram of this circuit.

The use of the LT-1070 can be altered to provide negative as well as positive voltage outputs of low to higher voltages from a single 12 volts input supply. This circuit has application in our microwave portable use in that most surplus relays and associated equipment are made to operate from 24 volts in military surplus. Surplus telephone microwave equipment is made to operate from 24 or 48 volts and positive ground. This little switching regulator will fill the bill to provide operation from either scenario, positive or negative output. Input voltage can be a car battery (12 volts), negative ground in either case, as in the circuit shown in Figure 4.

For the other polarity of operation for the majority output of this circuit, use the schematic shown in Figure 5, with a negative output at 24 volts. This is not the last straw but rather one method to show an application for this type of power supply.

As far as component selection goes for switching power supplies, an increased cost in their construction is necessary due to the higher value of filtering capacitors. Additionally, the inductors used must be capable of carrying a high current with very low resistances (less than 0.2 ohms), and the rectifiers must be switching-rated; that is, they must be a very fast rectifier specifically designed for switching-type use. A 1N4000 series rectifier is not suitable for this application; however, a Motorola MUR415 or similar ultra-fast recovery rectifier is rated for switching use.

Updated Loran Program Generates Gridsquare (by K9EUI)

The sidebar shows an update to the Loran receiver program. This new program was written by Bob K9EUI and is quite an improvement to the basic program presented in the August 1994 "Above and Beyond" column. Bob did a very fine job, and deserves quite a bit of credit for his innovations in adapting the concept we mentioned: merging the Loran and grid square location programs. Thanks again, Bob, for your fine contribution to this project.

The updated program allows for variation in latitude and longitude, with the mean average to be displayed along with the position status and grid square. Bob also included a signal strength indicator circuit for the Loran receiver (see Figure 6 for details). The input signal at the test point runs about 8 volts peak-to-peak, and averages around 2.5 VDC. The meter circuit can be very useful for mobile work, while an o-scope is the best way to monitor signal conditions in the shack. The test point to connect to is the second hole from the corner mounting hole (see Figure 6). I have to take my hat off to Bob for his very fine contribution to this Loran project.

Well, that's it for this month. I have been very busy with family activities and haven't had much time to spend in the shack working on construction projects. One nice test equipment update is that the noise meter that our group has been using was thought to have 5 dB of excess noise ratio (ENR) for noise figure evaluation. Well, we found it to be 4.3 dB ENR, and that gave us a big improvement concerning past noise figure measurements. It makes previous readings much lower and better than we thought. It's always nice to get some good test equipment to confirm calibration.

Next month I plan to cover microwave stripline tuning procedures. The methods are not frequency/band selective, as the Method Of Procedures (MOP) apply to all static-sensitive GaAs FET circuitry. This MOP'ING up will make working with sensitive GaAs FETs quite easy. As always, I will be glad to answer questions concerning this and other related topics. Please send an SASE for a prompt response. 73 Chuck WB6IGP.

See the program listing on page 70

Computer Program for Loran Receiver Boards (by K9EUI) (Program Derives Six-Figure Gridsquare)

```
10 ON ERROR GOTO 970
20 OPEN "I",#1,"LORAN.INI"
30 INPUT #1,P,C1$,C2$
40 CLOSE #1
50 CLS:KEY OFF:DIM X$(40)
60 L=900000!:N=1800000!
70 CLOSE:LOCATE 3,26:PRINT"LORAN Navigation System"
80 LOCATE 4,26:PRINT"________K9EUI__________"
90 LOCATE 6,30:PRINT"1. System setup":LOCATE 8,30:PRINT"2.
Run Program"
100 LOCATE 10,30:INPUT"3. Quit ",X
110 IF X=1 THEN 1020
120 IF X=2 THEN 140
130 GOTO 950
140 LOCATE 6,30:GOSUB 670:LOCATE 8,30:GOSUB 670:LOCATE
10,30:GOSUB 670
150 LOCATE 25,10:PRINT"      <ESC> to quit     <SPACE> to
clear max/min readings";
160 ON P GOTO 170,180,190,200
170 OPEN "COM1:1200,N,8,1,RS" AS #1:GOTO 210
180 OPEN "COM2:1200,N,8,1,RS" AS #1:GOTO 210
190 OPEN "COM3:1200,N,8,1,RS" AS #1:GOTO 210
200 OPEN "COM4:1200,N,8,1,RS" AS #1
210 LOCATE 9,26:PRINT"LAT    LONG    ST POSER MODE"
220 C$="I "+C1$+" "+C2$:GOSUB 330:GOSUB 350
230 C$="OD":GOSUB 330:Z=1:GOSUB 350
240 '
250 C$="A":S=0:GOSUB 330
260 GOSUB 350:IF Z=1 THEN A$=""
270 A$=MID$(A$,3,27):GOSUB 690
280 LOCATE 10,26:GOSUB 670:LOCATE 10,26:IF B$="N" AND
G$="11" THEN 300
290 PRINT A$;:GOTO 310
300 COLOR 15,0:PRINT A$;:COLOR 7,0
310 A$="":C$="B":S=1:GOSUB 330:GOSUB 350:GOTO 250
320 '
330 PRINT #1,C$;:PRINT #1,CHR$(13);:PRINT #1,CHR$(10);:RE-
TURN
340 '
350 D=0
360 X$(D)=INPUT$(1,#1):IF S=1 THEN 380
370 A$=A$+X$(D)
380     FOR I=1 TO 100:NEXT
390 V=EOF(1):IF V=-1 THEN 410
400 D=D+1:GOTO 360
410 IF S=1 THEN GOSUB 440
420 RETURN
430 '
440     FOR I=2 TO 5
450     IF X$(I)="F" THEN H(I)=15:GOTO 610
460     IF X$(I)="E" THEN H(I)=14:GOTO 610
470     IF X$(I)="D" THEN H(I)=13:GOTO 610
480     IF X$(I)="C" THEN H(I)=12:GOTO 610
490     IF X$(I)="B" THEN H(I)=11:GOTO 610
500     IF X$(I)="A" THEN H(I)=10:GOTO 610
510     IF X$(I)="9" THEN H(I)=9:GOTO 610
520     IF X$(I)="8" THEN H(I)=8:GOTO 610
530     IF X$(I)="7" THEN H(I)=7:GOTO 610
540     IF X$(I)="6" THEN H(I)=6:GOTO 610
550     IF X$(I)="5" THEN H(I)=5:GOTO 610
560     IF X$(I)="4" THEN H(I)=4:GOTO 610
570     IF X$(I)="3" THEN H(I)=3:GOTO 610
580     IF X$(I)="2" THEN H(I)=2:GOTO 610
590     IF X$(I)="1" THEN H(I)=1:GOTO 610
600     IF X$(I)="0" THEN H(I)=0
610     NEXT I
620 T=H(5)+16*H(4)+256*H(3)+4096*H(2)
630 IF T>8000 THEN T=T-65536!
640 OSC#=8*T/256+8000000#
650 LOCATE 6,26:GOSUB 670:LOCATE 6,26:PRINT
"OSC=";OSC#;"Hz"
660 Z=0:RETURN
670 FOR I=1 TO 30:PRINT CHR$(32);:NEXT:RETURN
680 '
690 B$=MID$(A$,25,1)
700 G$=MID$(A$,16,2):IF G$<>"11" OR B$<>"N" THEN 860
710 E$=MID$(A$,1,6):E=VAL(E$)
720 F$=MID$(A$,8,7):F=VAL(F$)
730 IF E>K THEN K=E
740 IF E<L THEN L=E
750 IF F>M THEN M=F
760 IF F<N THEN N=F
770 LOCATE 13,26:GOSUB 670:LOCATE 13,26:PRINT"MAX LAT ="K
780 O=(K+L)/2:LOCATE 14,26:GOSUB 670:LOCATE
14,26:PRINT"AVG LAT ="O
790 LOCATE 15,26:GOSUB 670:LOCATE 15,26:PRINT"MIN LAT ="L
800 LOCATE 17,26:GOSUB 670:LOCATE 17,26:PRINT"MAX LONG="M
810 Q=(M+N)/2:LOCATE 18,26:GOSUB 670:LOCATE
18,26:PRINT"AVG LONG="Q
820 LOCATE 19,26:GOSUB 670:LOCATE 19,26:PRINT"MIN LONG="N
830 R=R+1:LOCATE 21,26:GOSUB 670:LOCATE 21,26:PRINT"TOTAL
READINGS=";R;
840 IF R=1 THEN BEEP
850 IF R>0 THEN GOSUB 1150
860 K$=INKEY$:IF LEN(K$)=0 THEN 890
870 IF K$=CHR$(32) THEN GOSUB 900
880 IF K$=CHR$(27) THEN CLS:GOTO 70
890 RETURN
900 LOCATE 13,26:GOSUB 670:LOCATE 14,26:GOSUB 670:LOCATE
15,26:GOSUB 670
910 LOCATE 17,26:GOSUB 670:LOCATE 18,26:GOSUB 670:LOCATE
19,26:GOSUB 670
920 LOCATE 21,26:GOSUB 670:LOCATE 11,26:GOSUB 670
930 R=0:K=0:M=0:L=900000!:N=1800000!
940 RETURN
950 CLS:CLOSE:END
960 '
970 IF ERL=20 THEN RESUME 1020
980 CLS:RESUME 70
990 '
1000 '                    SETUP
1010 '
1020 CLS
1030 LOCATE 12,30:INPUT"Select COM port (1-4): ",P
1040 IF P<1 OR P>4 THEN 1030
1050 LOCATE 14,30:INPUT"Enter starting LAT. (DDMM) ",C1$
1060 IF LEN(C1$)<>4 THEN 1050
1070 LOCATE 16,30:INPUT"Enter starting LONG. (DDDMM) ",C2$
1080 IF LEN(C2$)<>5 THEN 1070
1090 OPEN "O",#1,"LORAN.INI"
1100 WRITE #1,P,C1$,C2$
1110 CLOSE #1:CLS:RUN
1120 '
1130 '                 GRID SQUARE ROUTINE
1140 '
1150 LA=VAL(MID$(A$,1,2)):AM=VAL(MID$(A$,3,2))
1160 LO=VAL(MID$(A$,8,3)):OM=VAL(MID$(A$,11,2))
1170 OM=ABS(OM):IF LO<0 THEN OM=-OM
1180 LO=ABS(LO):LO=LO+OM/60
1190 AM=ABS(AM):IF LA<0 THEN AM=-AM
1200 LA=ABS(LA):LA=LA+AM/60
1210 QP=(180-LO)/20:C=INT(QP):I$=CHR$(C+65):R1=(QP-
C)*10:C=INT(R1):D$=CHR$(C+48)
1220                                       M1=(R1-
C)*24:C=INT(M1):M$=CHR$(C+65):QB=(LA+90)/10:C=INT(QB):J$=C
HR$ (C+65)
1230 R1=(QB-C)*10:C=INT(R1):L$=CHR$(C+48):M1=(R1-
C)*24:C=INT(M1):N$=CHR$(C+65)
1240 H$=I$+J$+D$+L$+M$+N$
1250 LOCATE 11,26:GOSUB 670:LOCATE 11,26:PRINT"GRIDLOC =
";H$;
1260 RETURN
```

ASK KABOOM

Number 23 on your Feedback card

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Troubleshooting Audio Stages

Over my many years of repairing things, I've noticed that, in radio gear, breakdowns don't seem evenly distributed. As with just about everything, power supply failures are at the top of the list. But, unlike with, say, VCRs, RF problems are far outnumbered by audio-stage troubles. Why?

Life Ain't Fair

Like the power supply, audio stages carry a lot of power and load. RF output stages work even harder, but they are built with all kinds of protection systems incorporated into their designs, mostly because RF output transistors and modules are so expensive. Also, with the antenna completely left up to the owner, the chance for disaster is just too great.

Audio amps, however, are cheap and seem simple enough that nobody bothers to protect them. That, of course, is not the case with high-fidelity audio gear. Lots of good stereo components are designed with speaker and output stage protection circuits. They're built in for the same reason RF outputs are protected—repairs can cost a bundle.

In your radios, though, the audio stages often are little more than an afterthought, "OK, we've got a signal, I guess we gotta make it big enough to vibrate the speaker somehow." Or, perhaps, "The microphone's gotta get to the modulator one way or the other." So, little effort is expended because, after all, this isn't a high-fidelity medium to begin with. And, with only a few watts of audio power, not much harm is likely to occur, right?

Wrong

Ah, if only real life could be like that! From what I've seen, *lots* of trouble happens all the time. So, let's take a special look at audio problems: what they are, why they happen and how to fix them.

Coming and Going

As far as the audio is concerned, your transceiver has two ends: the mike and the speaker. Let's start with the output side, because it has the most potential for failures. In order to vibrate a speaker cone hard enough for you to hear the radio under noisy conditions, such as in a car, the average HF or VHF/UHF mobile rig puts out a watt or two of audio. Most walkies put out 200-500 milliwatts. Compared to the typical output power of stereo equipment, these levels are peanuts. So why has your stereo kept working for 20 years when your ham gear has blown its audio amp? Well, when was the last time you ran your stereo at full blast and 10 percent distortion for hours on end? (I certainly hope you're not doing that, especially if you want to be able to hear when you get older!) That's exactly what happens with radios, especially in the car. It's not the absolute level that matters, it's the amount of power relative to the maximum design limit. If your HT is rated at 300 mW and you run it all the way up for a long period, that's as taxing to its amplifier as if it were running higher power but designed for it.

So, it shouldn't be surprising that audio output stages blow up. But, before you crack open the rig, make sure it isn't the *speaker* that's popped! While most of the speakers in mobile rigs, and nearly all of the external "communications" speakers, are rated to take the full audio output power of a typical mobile transceiver, they can blow now and then anyway. Test your speaker with an ohmmeter, or try using another speaker, as your first test; only if the speaker seems fine should you go after the amp. By the way, although it's possible for the speaker's voice coil to short, I've never seen that happen; virtually all the blown speakers I've run across have been open. So, if your ohmmeter test shows anything in the 8-ohm range, you can assume the speaker is good. Unless, of course, yours happens to be a 32-ohm or some other odd-value speaker.

HT speakers represent a special case. Unlike those in mobile rigs, many HT speakers are actually rated for power levels far below what the little radios' amps can deliver! I don't know whether the manufacturers do it to save cost or size, but using an underrated speaker is a bad idea, to say the least. I guess they figure that you won't be playing the rig at top volume for long periods, so the *average* output power will stay safely below what the speaker can handle. In car use, though, it just doesn't happen that way. Especially if you accidentally leave your squelch open with the volume all the way up, you may come back to find a dead speaker. Why would you ever do that? I've seen hams deliberately leave the radio with open squelch in order to run the battery down all the way before charging it. Heck, I've done it myself. If you do that, be sure not to set the volume more than about halfway up.

If the speaker is OK, it's time to open up the rig. Before you get to the amp, take a look at the earphone jack. Now and then, a bad connection or a bent piece of metal in the jack can prevent the signal from making it to the speaker. With PC-mounted jacks, the solder joints or PC foils can break from the stress of inserting and removing the plug. If all seems well, scope the line coming to the jack from the audio amp. If it shows a signal, you still have a connection problem. If it's dead (the more likely case), the amp isn't working. If you don't have a scope, you can test with a small speaker. Just connect one end to the common side of the existing speaker (usually chassis ground, but occasionally one of the power supply rails) and the other to the amp's output line, after any coupling capacitors or transformers. No sound means a dead amp.

Only Resting

When is a "dead" amp not really dead? When it's resting! Remember, this is a radio, not a stereo. So, it has a squelch circuit, right? You'd be surprised at how many seemingly dead amps are sitting there in perfect health, waiting to spring into action. To see if your problem is in the amp or the squelch circuit, test for voltages on the audio output stage. Except for a few older radios, just about all HTs, and many mobiles, completely remove the DC power to the audio amp when there's no signal. It really saves power, and it eliminates any annoying, residual noise from distracting the listener. If the whole thing seems dead, with no DC voltage present, you almost certainly don't have an amp problem, and changing the output transistors or IC won't do you any good. Now's the time to work backwards, heading for the squelch circuit.

The Gatekeeper

Many VHF/UHF radios, both HT and mobile, use the Motorola MC3357 or another similar IF/detector chip. This IC has a squelch output which consists of a rising and falling DC voltage. If you go from the audio amp's DC input point and follow it back toward the chip, you'll run into a transistor. This transistor acts as a gatekeeper, allowing the command from the chip to control the substantial current required for the audio output. Failures in this stage are extremely common, so take measurements on the transistor's base. If it rises and falls as you turn the squelch knob back and forth through its threshold, the chip is doing its job, indicating almost certainly that the transistor is open. If, though, you see no action, either the chip or the transistor could be bad. To find out, pull the transistor's base leg and measure the line coming from the chip. If it now works, the transistor is likely bad. If you still get nothing, the chip is suspect. Remember, though, that it could have been blown by a short in the transistor, so they may both need replacement. Before you change that chip, though, be sure both its oscillator inputs have their required signals, and that the IF input is there, too. Naturally, that squelch line will never become active unless the chip is seeing proper signals.

Types of Amps

Once you've decided that the problem is definitely in the audio amp, it's time to start narrowing the problem down. If the radio uses an IC for its audio power output stage, you don't have far to look; the chip either is or isn't bad. But, if it is, you might save yourself a few bucks down the line by thinking about why it blew. Heat buildup from turning the volume control very high certainly can do it, but there are other reasons. One of the most often overlooked is a leaky output coupling capacitor. The amp will still work, but it'll be putting DC power through the very low resistance of the speaker's voice coil, and that will make both the chip and the speaker run hot. The speaker may survive while the chip goes to that great silicon factory in the sky. It can be hard to determine a leaky output cap, so I recommend simply replacing it whenever you have an unexplained failure in a cap-coupled audio power amp. Otherwise, you could replace the chip, only to have it fail again a few weeks later.

If the amp is discrete, you've got a job ahead of you. Discrete amps are almost always of the push-pull variety, and their problems can be tricky to pin down. Usually, the parts carrying the most current go first, so check the output transistors. If there's a coupling cap, suspect it. If there's an output transformer, though, chances are it'll be OK.

Well, we've more to cover, but I'm running out of room. So, let's finish this up next month. Before we go, though, let's look at a letter:

Dear Kaboom,

I have an 80-meter folded dipole on top of a four-story apartment building. My problem is that, whenever I transmit, touch lamps all over the complex go on and off. The neighbors don't appreciate it, and I don't blame them. Is there any way to stop this?

Signed,
Blinky

Dear Blinky,

Ah, there is some justice in this world! Touch lamps have been QRMing hams as long as the little buggers (the lamps, that is) have been around. I've never heard of QRM *to* touch lamps, but it makes sense that it might happen. If the RF is getting in through the lamps' sensing antennas, I don't know how you could stop it without killing the touch action. But, if it's getting in through the AC line cord, which is what I suspect, any decent RF line filter ought to stop the problem. You mentioned in your letter that a ham friend once knew how to fix this but has since lost the instructions. If another reader can send a definitive fix, I'll be glad to put it in the column. Good luck!

Until next time, 73 from KB1UM.

NEVER SAY DIE

Continued from page 4

needed. Well, we're a little behind on that one. I remember HB9RF doing that in Zurich over 20 years ago as we were driving to visit his moonbounce station.

I've replaced what was only 10 years ago a state-of-the-art $500,000 computerized publishing production system with a new Macintosh $50,000 desktop system. It does it better and faster.

Are you still writing by hand? You're two generations behind. I changed to typewriters as soon as I could, carrying portables with me on my trips 35 years ago. Then I changed to word processors, moving to a laptop system 15 years ago, as soon as the first one was available. I moved from CW to voice in 1939 . . . and from voice to RTTY in 1949. I put up my first voice repeater In 1969. Our pioneering ham HTs and repeaters of 1970 are now used worldwide as cellular telephone systems.

And look what's happened to those crude microcomputer kits we were playing with in 1975! Now we're using micros to replace million-dollar typesetting systems. One of the first ads for the MITS Altair 8800, the first practical microcomputer, appeared in *73*, by the way.

Are you keeping up with technology? As a ham you're expected by the public to be knowledgeable about high-tech. Can you see where technology Is taking us? All you have to do to get ahead of the game Is know something like that before others do. Joe Sugarman W9IQO figured out that there would be a market for electronic gadgets, so he started selling them by mail as JS&A and made millions. Steve Jobs figured there was a market for a single-board microcomputer, and didn't do badly. Bill Gales figured these micros would need operating systems and parlayed that idea into a few bll.

If you really want to feel bad you can dig out some old Issues of *73* and read where I told anyone paying attention about those opportunities at the time. There are just as many opportunities today, If you think in those terms. Steve Jobs started out with nothing but a prototype built by Steve Woznlak. Bill Gates dropped out of Harvard to work for MITS, in Albuquerque, where the action was.

Communications, computers, information and transportation systems . . . all are changing. These changes, in turn, are changing businesses and industry. They're wiping out the need for so many management layers. They're making it possible (and that translates as necessary) to move manufacturing to lower-wage countries.

We're in need of and ready for a major change in education which I expect will generate a few more billionaires. Ditto health care, which is a trillion-dollar industry, and growing fast. How close are you to the change? Close enough to benefit?

Of course this means that you're going to have to actually *do* something. You're going to have to spend time learning and perhaps experimenting. It Is pathetically easy to become an expert In a new technology. It just lakes an Interest and some dedication.

When I heard the first RTTY signal on my 2m receiver I wondered what on earth that was and started asking questions. That lead me to John Williams W2BFD, the grandfather of ham RTTY. I built the circuit he'd developed, bought an old Model 12 Teletype machine from him, and was on my way. I read all I could find, asked endless questions, and experimented. The next thing I knew *I* was the expert and writing the first book on the subject.

In my editorials I'm endlessly pointing out new areas of technology that are wide open for development and which offer great promise for building new businesses. I've been writing recently about cold fusion. I expect this to turn into a trillion-dollar industry within a few years, sweeping some of the pioneers along into billionaires. It'll not only wipe out established businesses that ignore it, but many of the pioneers who don't keep their eyes open to how the field is developing.

Many of the microcomputer pioneers went under because they stopped keeping their eyes on the future and thus weren't sensitive to changes. I tried hard to convince John Roach, the president of Tandy, that the future of personal computers lay in making them with open systems so that third-party firms could support them with software and accessories. Roach wouldn't listen and this cost Tandy tens of billions. It was Roach who was far more responsible for the success of IBM and their PC than IBM was. IBM should give him a medal.

The opportunities are there. They are sitting there just waiting for anyone with the interest to pioneer and reap the rewards. It does take work. It means learning. One thing it doesn't take is much money. Bill Gates didn't have any money when he approached Ed Roberts at MITS with the BASIC Interpreter he'd quickly cobbled together. Steve Jobs didn't have the airfare to fly to the Atlantic City computer show with his Apple I prototype in 1976. The two guys who started Electro-Voice started in a garage, just like Jobs and Wozniak.

The question then is: Are you willing to learn? Are you willing to work? Or are you too busy watching ball games on TV or swapping signal reports for QSL cards so you can end up a Silent Key on the ARRL Honor Roll? Instead you could be learning about spread-spectrum communications, data compacting algorithms, or maybe how to load hydrogen into nickel to generate heat, and then start working on ways to control the process and use it for heating systems and to generate electricity.

Presumably, since amateur radio is supposed to be a technical hobby, you have some grounding in electronics. That's a good start, but why stop there? Oh well, it's your life. If you're already making enough money, don't have any interest in helping civilization progress, and don't get fun and excitement from pioneering, then sit back with a beer and pretzels and enjoy. Let others develop better foxhunting receivers. Let others put up crossband repeaters. Let others run your local radio club. Let others elmer newcomers. Let others develop better, faster packet systems. Let others write the articles you're reading.

Speed Reading

One of the better moves I've made in life was In taking a speed reading course at the local high school. Before that I was bumbling along at a crummy 300 words per minute, reading word by word, just as they taught me in school. At that speed there would be no way I could handle the homework that I need to do to keep up these days. As it is I zip through over a hundred magazines a month, lord knows how many letters and submitted articles for my magazines, plus two or three books a week. Very few novels, either. Well, I *do* read each new Tom Clancy book when it comes out. There goes Wayne, bragging again, right? No, my point is that I haven't done anything you couldn't do . . . il you'd just *do* it.

There are undoubtedly some fine computer programs to help you speed up your reading, but you don't need 'em. The process is really simple. it's like learning the code in that no amount ol slow reading is going to speed up your ability to read. If you want to read faster, what you have to do is start pushing yourself. If you don't want to read faster, why not? There's no downside, and the upside can be amazing. It's easy to triple or quadruple your reading speed. And the suiprlsing part is that the faster you read, the more you retain. That's right, comprehension improves!

Instead of reading one word at a time, push yourself to read two and three. Push harder. Then go to four and five. Pretty soon your eyes will be seeing a whole line at a time and you'll be reading by running your eyes down the middle of a column of text. You'll be able to whip through fiction like a breeze. Technical stuff Is slower, of course.

Before you start pushing, measure your current reading speed, so you'll know how well you're doing. Pick a full page of text and time yourself. After you've been pushing to read faster for a few days, pick another page and test again to see how much speed you've picked up. I think you'll be pleased. Keep right on pushing and let me know how you're doing.

Make Some Money

I recently got one of these new-langled HTs with multiple-use buttons. Now, I'm no newcomer to HTs. I started out with an HT-220 Motorola unit back in 1969. That was a very nice, rugged, and compact HT. It had one frequency and was crystal-controlled. It was on 34-94 and worked like a champ. It had a squelch control with the on-off switch on it, a volume control, and a simplex-duplex switch. Period. I had no problem at all using it.

So here I am with this new two-band HT. It's got 24 buttons, two concentric control knobs, a tuning dial, and a 60-page instruction manual. Then there's the fuction display with 25 different areas for information. It's got 64 programmable channels and I know I'm going to need to be retrained after every coffee break.

Sure, I'll probably be able to sweat my way through the 60 page book and figure out how to do the simple things, but the lesser-used functions will go the old use-it-or-lose-it route in what's left of my memory. Heck, this HT has a better memory than I have. Maybe I need a crib sheet. That's what I've cooked up to help me cope with my Mac PowerBook laptop computer. But then it's got about a 500-page instruction book, plus another 500 pages for Word, the word-processing program I use.

Both of those books are so complicated to deal with that several publishers are selling simplified instructions for the computer and the program, and those books run at least 500 pages. I've been buying more and more books to help me cope with this tiny monster, and I've over six feet of bookshelves filled so far, with no end in sight. My wife Sherry, who's been Macintoshing it several years longer than I, has over 50 feet of software and books.

I hate to think what I'll have to do if I move from Word to Quark for page design. Sure, I'll be able to do a lot more, but at what cost in time and aggravation to beat my way through instruction books which are not user-friendly? It's no wonder they're selling video tape Instructions for these programs. And I get ads in the mail for one-day courses in Quark for a couple hundred dollars.

One major problem is that most of these books have been written by hardware or software engineers, not writers. One of the great charms of the original TRS-80 Radio Shack computer was that the instruction manual was easily understandable. I just wonder If there might not be a market for simplified ham gear Instructions. I know I'd buy 'em in a flash.

Many ham manufacturers are still letting their engineers write their instruction manuals, despite my warnings in past editorials about never letting an engineer get close to such a project. Just as they shouldn't be let near any advertisment writing. Engineers have their function . . . to design equipment. Technicians fix it. But when you need writing done, get a writer. Engineers have their own language, often not recognizable as English. Many seem to almost completely lose their ability to communicate in English through disuse.

If you know how to write, and you've conquered some popular piece of ham gear, you might try your hand at writing a simplified instruction manual for it. If I'm able to understand it, I can offer photocopies via Uncle Wayne's Bookshell

and see how it sells. Who knows, you might be able to generate enough cash to buy more equipment and then provide understandable instructions for that.

Legacy

In a hundred years what will there be around to show that you've been here? Probably the only thing will be your grandchildren and their children. So much for your life's work . . . all the money you've made, and your lifestyle. Sure, a few people leave noticeable things behind. Music, or some sort of art . . . maybe a bridge or a building they designed. But for most of us it's our children that are a record of our having been here.

Nature has gone to a lot of trouble to make sure that we generate children, so it's an almost sure thing that we will. But since this will probably be the only long-term reminder that you ever existed . . . except perhaps for a gravestone, which I doubt will get a lot of attention a hundred years from now . . . shouldn't you maybe spend some time and effort making sure that your progeny are the best that you can turn out? And no, this is not a trivial project. However, considering its importance, perhaps it's worth investing some time and effort in it. Or is it already too late for you?

No, I'm not going to go into detail here on how to have the best possible children. There's nothing simple about it, and our present customs and life styles are so destructive as far as this goal is concerned, that you may not even want to know. We're permanently lousing up our children even before conception. Then we're doing another number on them during the nine prenatal months. That's followed by an even worse approach during their first year, followed by (ugh) pre-school. The products of these botches are then fed into one of the worst school systems in the developed world. Is that what you want to leave as your legacy? It's no wonder we're up to here in lawsuits, crooked politicians, crime, drugs, welfare, and other such scams.

Yes, I'll try to make time to start writing a book on how to give your children the best send-off in life you can . . . preconception, prenatal, birth, the first year, pre-school, K-12, and then college. If it's too late to help you with your children, maybe it isn't too late for your grandchildren.

If there is such a book I haven't seen it, so I'll have to go into detail on each step, ending up with a "How To Have and Raise An Outstanding Child" manual, complete with repair instructions when mistakes are made.

Most of the information I've gotten has been the result of my research into education and health care for the New Hampshire Economic Development Commission. I sure wish I'd known about all this when I was getting my children started.

Anomalies: The Awesome Power of the Mind

How well have you been keeping up with technology? Science has been moving along at an ever-increasing rate. Has this been leaving you behind? How well do you understand quantum theory? How about Chaos theory and fractals? How about DNA, genetics and the genome project? How about the Big Bang, plate tectonics, and the Omega Point? How about bioelectrics and bioelectromagnetism? How about cold fusion? As a licensed radio amateur . . . someone supposedly educated in electronics and communications . . . shouldn't you be keeping up with the world of science?

And how do all of these recent theoretical developments tie in with ineffables such as precognition, ESP, psychokinisis, faith healing, placebos, ghosts, reincarnation, past lives, UFOs, auras, psychic surgery, near death experiences (NDEs), out of body experiences (OBEs), and so on? Are all of these the "swamp gas" the professional debunkers (aka skeptics) claim? It seems logical to me that when the same phenomenon is reported by many people who have had no way of knowing that others have reported these experiences, that it's worthy of serious investigation and calls for an explanation . . . no matter how unusual the experiences.

If you've been keeping up, as scientists have delved deeper into quantum theory, they've been faced with some very serious problems. Matter no longer behaves rationally when you get down below the atomic level. Physicists have been struggling with a nightmare of ever more particles, often with conflicting behaviors, depending on the group working with them. Newtonian physics doesn't hold any more.

We have some very basic problems we've been ignoring. For instance, we don't know what fields are or how they happen. Oh, we can measure them and predict their effects, but that doesn't mean we know *what* they are. We have electrostatic, magnetic, gravitic, and electromagnetic fields (EMFs) over a wide range of frequencies. We know now that very low frequency EMFs can interfere with cellular growth and communication in living things . . . including people. We can measure gravity fields, but we really don't know what they are. We suspect there may even be more fields which we haven't yet detected.

We know that what we perceive as matter is really energy fields oscillating at certain frequencies. What we don't know is if there might be other forms of "matter" oscillating at different frequencies, and thus might be completely invisible to us, even though we might be right in the middle of it. We can hear a small range of audio frequencies. We can see a very narrow range of light frequencies. We can detect those in be-

tween and use many for communication. But those are electromagnetic waves. Detecting gravity "waves" is much more difficult.

We tend to be arrogant about what we know. You've probably read about the head of the Patent Office who proposed closing it down about 90 years ago on the basis that everything fundamental had already been discovered. The patent office today has refused to issue any cold fusion patents because there are a few well-placed scientists stopping the process.

From my point of view anomalies . . . those things which are reported by people in many parts of the world, but which are not yet explainable in scientific terms . . . indicate that we've still a long way to go before we really understand our world.

I've editorialized in the past about memory. I've mentioned that under hypnosis people can be regressed to any instant of their lives and recall in total detail what was being sensed at the time. Every face in a crowd is recorded in some way. Every word on every page we've ever glanced at. Unfortunately we're programmed by our parents from early childhood not to be able to access most of these memories.

But we run into a physical problem. How can so much material be stored just in the brain? No mechanism has yet been discovered which can handle the sheer bulk of information we're able to store. I've suggested that perhaps it isn't stored on a molecular basis like a computer, but in some other kind of medium entirely. A controversial new theory has been proposed which is in line with this concept, plus it ties together many anomalies which have been bothering me, into one completely new paradigm.

Scientists have been at a loss to explain why people who've had large parts of their brains destroyed or removed can still have all of their memories. How can 90% of the brain be removed without a loss of memory? It doesn't make any sense. Well, not if you insist that the brain is the mind and that it's wholly a physical, molecular thing, much like a computer. And that gets worse when you find another person with a different 90% of the brain removed, and still without a loss of memory. Whoops!

And what about the thousands of people who can see auras around people? What about people who can accurately diagnose illnesses just by looking at these auras? At times we get hints of some amazing latent potentials we all seem to have. We have people who have demonstrated abilities under strict scientific controls which suggest that, if we only knew how they did these things, we might be able to learn how to do them too.

Perhaps, instead of spending millions on disease research we might invest in learning how the mind works and prevent disease from that end. We know that there is a psychological component to every illness. We also know that our current medical approach is to completely ignore this key factor and try to treat the resulting illness symptoms . . . preferably with drugs.

Our pharmaceutical companies spend an average of $230 million for every new drug they bring to the market. I suspect that if there was some way to channel the cost of one new drug into mind research we might not have much use for drugs any more. And that's the real problem with this approach. The pharmaceutical industry is making hundreds of billions selling drugs . . . which is why they don't mind investing a couple hundred million bringing a new drug to market, or even spending over a billion dollars a year on advertising. But if removing the psychological component which has triggered the illness is possible, these businesses could quickly dry up and blow away. It's worth a few billion to make sure that doesn't happen, so the possibility of either a commercial firm or the government venturing into this field of research is much less than even remote.

The so-called health care industry has too much at stake to even chance this approach working. It's actually a sickness-care industry and it's one of our largest American industries. What would happen if someone discovered how to remove the psychological triggers making people sick? That would put most of our doctors, nurses, hospitals and so on out of business. It probably would even prolong life, working a severe hardship on our death industry too.

I've explained how the mind works. I explained that painful experiences set up neuron networks dedicated to helping you avoid repeating the pain in the future. I also explained that these subconscious forces have an incredible effect on our daily lives. And I explained that it's not just possible, but fairly easy to dissolve these networks. I've had a few letters asking for further information on doing that, but not enough demand to get me to sit down and tackle the project.

Getting back to a new approach to eliminating illness, you've probably read about how successful many non-medical doctors have been. Witch doctors, shammans, medicine men, Christian Scientists, and so on have been doing remarkably well, some for thousands of years. If they didn't have a fair percentage of successes they wouldn't have lasted.

When we look at people with multiple personalities we find some fascinating things going on. Most multiples have six or more personalities, each quite different. These seem to be a survival reaction to very painful childhoods. The interesting thing is that some of the

personalities may have diabetes, while others don't. Some personalities may have epilepsy. Often different personalities require different eyeglass prescriptions . . . and some don't need glasses at all. As I say, it's almost enough to make a person think!

Then we get into the power of placebos and realize that many people have demonstrated the ability to recover . . . or die . . . from cancer just on the basis of a belief in some therapy. There are many fantastic cases to prove this.

OK, we already know that every illness has a psychological component. And we know that medicine men have been surprisingly successful without the benefit of "modern" medicine. And we know that voodoo and witchcraft can cure or kill, as can placebos. I've mentioned that when I was working professionally as a psychologist I found it fairly easy to discover these illness-triggering factors. The next logical step seems to me to untie the hands of our research people and urge them to go after curing illness via erasing the psychological component of the illness rather than bigger and better medical electronic diagnostic equipment and $230 million each for new drugs to treat the symptoms, but not the causes. Would you say this is so ridiculous an approach that we shouldn't even consider it?

Of course the problem with this is that we have the fox guarding the henhouse. What commercial company is going to spend money trying to discover something that might well put our pharmaceutical companies out of business, yet probably wouldn't bring money in? And perhaps put most hospitals, clinics, doctors and nurses out of business too? There's enough money to be made by bringing a new drug to market to warrant a $230m research investment, but how could anyone make money from a simple instant cure for illnesses? Maybe even for almost every illness?

We've got the teacher's NEA spending tens of millions of dollars on Congress and state legislatures to vigorously guard one of the worst educational systems in the developed world against change. We've got the power utilities guarding against truth in the damage their magnetic radiation is doing to us. The government-subsidized tobacco industry is still denying that there's any real proof that cigarettes cause illness. Imagine what resistance our trillion-dollar "health care" industry would put up if someone suggested there might be a way for us not to get sick.

We know the government isn't going to finance research into an omnibus cure for illnesses. Nor will private companies. So it looks as if we're going to have to live with ever-escalating sickness costs and much shorter, unhealthier lives than are possible. Pity, because I suspect that the solution wouldn't take long to develop.

Maybe you've noticed that virtually every major problem we have in America seems to stem from some action or inaction of Congress. My solution to that impasse is simple: NRA . . . Never Re-elect Anyone. If we can get rid of career politicians we're going to benefit. For every good politician (a contractiction of terms?) we might lose, we'd evict a hundred bummers. My NRA could be the National Recovery Act of the '90s.

What have you to gain? Better and cheaper health care, infinitely better education, no more welfare, taxes reduced by at least 50%, a far smaller bureaucracy, a 90% reduction in crime, and things like that. It's up to you to choose which you prefer.

The Helicobacter Pylori Syndrome

If you don't read *The New Yorker* you are missing out on a lot of good stuff. Oh, not in every issue, but enough to make a subscription well worth while. For instance, last year they ran a great article in their "Annals of Medicine" series on a doctor who suspected that ulcers weren't caused by stress, but by a germ called Helicobacter Pylori, and not by emotional problems or stress.

Despite enormous pressures from the medical establishment, which did all it could to prevent him from doing research, and then from publishing his findings, he eventually prevailed. Now most doctors accept his work.

And *The New Yorker* also was the first to publish Paul Brodeur's material on power line fields and their effect on people, which to many people who have not bothered to read much about this, is still controversial. Of course, to the cigarette companies, the harm their product does is still "controversial." But, as they themselves have been quoted as saying, their product is used by the young, the blacks and the stupid. Or did you skip watching that well-done TV report on smoking?

All too often we've seen this happen in many scientific fields. If you can get away for a few days, see what you can do to attend the Tesla Society Extraordinary Science conference in Colorado Springs. I went last year and I'll be going again next. Sure, they have some absolute crackpots presenting papers there. But they also have some well-researched papers that might just get you to thinking. Check with the International Tesla Society, Box 5636, Colorado Springs, CO 80931. Quite a few hams attended last year, and they even had a conference ham station set up and running . . . and leaking sideband into their public address system.

The Subtle Energies conference (ISSSEEM) is another conference worth attending. They are much more picky about the papers presented than the Tesla group. I attended their conference last year and found the presentations well researched. But you'll have to be prepared to hear papers on energy medicine, auras, and so on. I was particularly impressed by a video of a psychic healer influencing a cloud chamber on cue from several hundred miles away. And also changing the surface tension of water remotely. This is where you'll learn more about light therapies, bioelectromagnetics, and so on. You can get more info on this from ISSSEEM (the International Society for the Study of Subtle Energies and Energy Medicine), 356 Goldco Circle, Golden CO 80401. Tell 'em Uncle Wayne sent you. If you're there next time we can sit together and discuss what we're hearing. I was the only ham there last year. Tsk.

As I've mentioned, we still have an enormous number of things to learn about our world. We're still blundering around trying to understand how atoms work. We haven't a good understanding of any fields yet, including magnetic and gravity. We don't understand how electricity flows, or what electrons are. We're still trying to understand inertia and time. Sure we have equations for all these things, but we just know how they work, not why.

I suppose you were too busy watching some stupid sitcom instead of the wonderful PBS series on psychology. I don't know, you discourage me sometimes.

And then I get letters from readers who've been reading the books I've recommended, and I am encouraged. Quite a few have sent me wonderful letters telling me how much they've gotten from Becker's *Cross Currents*. While I try to answer any questions readers ask, I generally don't write back unless there are questions, so I'd like to take this opportunity to thank the many readers who've bought my *Declare War* book and enjoyed it.

Now, what will it take to get you involved in doing some research and development? Wait'll you see what happens when you plant a row of seeds which have been treated in different ways before planting! I got a call from a reader the other day who has been treating seeds so they turn out humongous plants, vegetables and fruits. Forty-foot corn plants with 12" diameter corn cobs? Well, that's what he said. But then he's a big believer in Wilhelm Reich's orgone. Yes, I've read Reich's book, *The Discovery of the Orgone*. It came close to making me a believer. That close.

So what happens to seeds germinating over the north or south poles of magnets? Or over positive or negative electrostatic fields? In different colors of light? In magnetic fields of different frequencies?

Knowing how badly the scientific establishment has treated new discoveries in the past, I wasn't surprised at the shabby treatment Pons and Fleischmann got when they announced their discovery of the cold fusion phenomenon. Well, as they say, "Time wounds all heels."

So, have you read about Heliocobacter Pylori? If not, you aren't doing your basic homework. 73

An 80/40/30m Tripole

Continued from page 40

might expect, but gives me really quite good coverage N-S as well! I tend to run between QRP and low power most of the time, and have no trouble with Michigan and Canada to the North, the Gulf states, the Caribbean, and South America to the south. East and west to the coasts is about it so far in the eight months or so the latest model has been up, but I have a good feeling that Europe, Africa, Asia are not in any "dead zone" for the antenna—I am just not on enough hours, or the right hours, to have worked them. Remember, propagation either gets or helps you to the N-S, but time zones alone can kill you to the E-W. California to Europe on the 40 & 80 meter bands must be murder. By the time those bands come alive at night in California (terminator passes into darkness), Europeans are sound asleep! Life just is not fair (well—not easy, anyway).

A friend has come up with the possible reason that the antenna works so well on 160m, even without the tuner: The 86' of coax feeding it works out to be right at 1/2 wavelength at the 160m frequencies I have been using! Since I ran directly into the antenna with no balun or any kind of ferrite beads or rolled up coax to form a choke at the antenna input, the odds are quite good that the feedline is making up a portion of the radiating antenna. If that were the entire case, I would buy it in a minute, but the contacts so far seem to indicate that 160m use favors E-W, and if the coax were radiating (remember, it runs from ham shack East to antenna) I would think N-S would be favored on 160m. Whatever, it works really well and somewhat omnidirectionally on the three bands I built it for, and it sure is not too shabby on the extra 160m band!

It would not be fair to tell you that from the FT-990 into the antenna on *all* four bands, the SWR is absolutely FLAT, with very little work by the built-in antenna tuner in the radio; were it not for the fact of so many radios now having the tuner built in, and/or so many fine tuners being available at very reasonable prices. I never favored letting the tuner do the work we should do when building the antenna, if for no better reason than that even with a tuner you are *not* getting best antenna efficiency if the tuner does the work. The ideal is to have the antenna *flat*, a good 50 ohm match, and look good *before* the tuner is ever used. Tuners are good guardians for radios when we *have* to tune and load into wet noodles like Field Day or during emergencies.

Finishing Touches

I'll leave you with a few tidbits for those of you diehard antenna types like me. I did all the cutting, trying, and measuring with very reasonably-priced MFJ antenna gear. I used the MFJ Antenna Bridge 204B in developing the antenna, and the MFJ SWR Bridge 249 in trying to grade and classify it. Both served me well I think, considering the very good results (contacts) I have been able to make. It is *not* a full-size yagi or quad on any of those bands, but it *is* a classy set of dipoles that build up easily and work well.

One thing that may help you that came as part of the directions for the MFJ gear is an approximation formula that should work well for any type of accurate SWR bridge. You use the idea by first noting the design center frequency (desired). If you are using an SWR bridge *please* use very low power while doing these tests—for the rig's sake, and for the sake of the others on the bands as well. Once everything is up in the air (mine is right at 24' at both the apex and the ends—*not* terribly high), then take SWR readings over a spread of a band (starting with 80M). If you are unlucky enough to be off as to where you want the SWR to be best (design center frequency), then the following can save you a lot of time. Enter the formula and use from the MFJ book.

Credits:

Ideas for multiband dipoles with common feeds came from "Short 80 through 10 Meter Band Ham Antenna," by Richard A. Yommus W2DMK, *Popular Electronics* magazine, April, 1973.

Simple Novice and wire antenna ideas came from "Novice Antenna Specials," by William E. Hood W2FEZ, *73 Magazine*, date unknown.

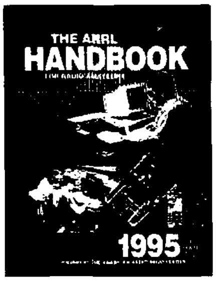
Some ideas about cages, spacers, band-sharing common feedlines came from "The Extreme Basics of Antennas," by Robert M. May II WA4DBG, *73 Magazine*, date unknown.

Number 25 on your Feedback card

NEW PRODUCTS

Compiled by Charles Warrington WA1RZW

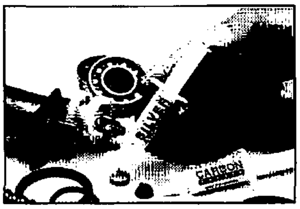
ARRL



The American Radio Relay League has announced publication of the 1995 *ARRL Handbook for Radio Amateurs*. Now in its 72nd edition, the *Handbook* is considered an authority on technical matters for amateurs and others interested in communications technology. More than 6 million copies have been sold since 1926.

The 1995 edition has been entirely rewritten and contains material superseding all previous editions. New chapters provide a snapshot of amateur radio in the '90s.

The *Handbook* is available at your favorite dealer or bookseller, including "Uncle Wayne's Bookshelf" on pages 86-87. Or contact *The Amateur Radio Relay League, Inc., 225 Main Street, Newington, CT 06111; (203) 666-1541.* Or circle Reader Service No. 202.

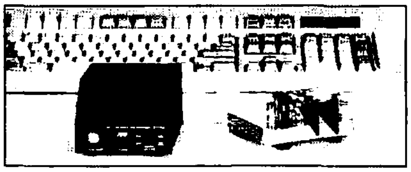


PLANNED PRODUCTS

Planned Products has introduced two new greases developed for applications requiring electrical conductivity, lubrication, and protection. Available in silver and carbon formulations, the new Circuit Works Conductive Greases protect assemblies from wear and from environmental hazards while providing excellent electrical and thermal conductivity.

When used at low to medium speeds, the 7100 Circuit Works Silver Conductive Grease, and 7200 Circuit Works Carbon Conductive Grease lubricate and protect assemblies while forming conductive pathways, contacts, connections, static drains and grounding. Based on advanced silicone lubricants these new greases are chemically inert, thermally stable and nonflammable. Assemblies are protected from moisture, oxidation, radiation, corrosion, and corrosive atmospheres with a single application.

For more information or to order contact *Planned Products, 303 Potrero Street, Suite 53, Santa Cruz, CA 95060-2760; (408) 459-8088, FAX (408) 459-0426.* Or circle Reader service No. 203.



MFJ

MFJ Enterprises has introduced the MFJ-452 Super CW Keyboard, including a two-line LCD display and RFI Supressed Keyboard. This product includes plenty of features and accessories you may not expect to see.

The MFJ-452 features eight 250-character nonvolatile message memories, a 150-character type-ahead buffer, an iambic keyer, and a powerful Morse Code Trainer. Simply turn this unit on and you're sending effortless CW—no computer to boot-up, no program to load. The Perpetual Memory means you can save messages and settings for 20-years without power or batteries.

The MFJ-452 includes a speaker, sidetone, volume control, and jack for external speaker or earphones. The MFJ-452 is priced at $129.95; the MFJ-452X is the exact same model without the keyboard, priced at $99.95. For more information or to order contact *MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762; (601) 323-5869, FAX (601) 323-6551, (orders) (800) 647-1800.* Or circle Reader Service No. 206.

CAIG LABORATORIES

Caig has introduced an environmentally safe aerosol for its ProGold product. ProGold is a high performance contact cleaner, enhancer, and lubricant that needs no carrier solvents for dilution or cleaning surfaces. The spray container provides short bursts of 100% concentrate via a precision metered valve.

The unique properties of ProGold allow it to deoxidize, clean surface contamination, and penetrate plated surfaces to molecularly bond to base metals—no other product does this. It fills the gaps in the contact surfaces to increase the effective contact area and prevent current concentration at surface peaks.

The result is current is distributed more evenly across the contact surfaces. This increases conductivity and contact surface area and reduces arcing, RFI, wear, and abrasion (the major cause of intermittent signals, distortion, and signal loss). For more information contact *Caig Laboratories, Inc., 16744 West Bernardo Drive, San Diego, CA 92127; (619) 451-1799, (800) CAIG-123, FAX (619) 451-2799.* Or circle Reader Service No. 201.

CUSHCRAFT

The new Cushcraft ASL-2010 Skylog Log Periodic antenna is the answer for hams who would like to have a single antenna that covers 10 meters through 20 meters (actually 13.5 through 32 MHz). This design eliminates the need for two Yagis to cover the traditional bands and 12 and 17 meters.

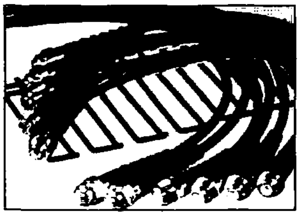
It uses single feed line (balun included) and thus there is no need to switch antennas when changing bands. This design does not use any traps of any type thus the wind load is reduced significantly (10.1 sq. ft.). The antenna is not power limited and will easily operate at full legal limit continuously.

The ASL-2010 boom is 18 feet (5.48 meters) long. The gain of the antenna is 6.4 dBd. Construction is of weatherproof aluminum and stainless steel. List price is $800. For more information contact *Ken Albertson, Cushcraft Corporation, P.O. Box 2680, Manchester, NH 03108; (603) 627-7877, FAX (603) 627-1764.* Or circle Reader Service No. 204.

RAYMOND SARRIO

Hams interested in generating community awareness will be excited by these new T-shirts from Ramond Sarrio Company. These eye-catching shirts feature a 4-color design that clearly communicates that amateur radio provides an essential public service when disaster strikes. There is also a circular 2-color logo on the left chest that states, "Amateur Radio—Dedicated to Public Safety." The sweatshirts have the 4-color "WHEN ALL ELSE FAILS" design on the front.

To help amateur radio clubs, a special fund raising program has been implemented: Clubs, without stocking any inventory, can earn up to $6 on each T-shirt and up to $8 on each sweatshirt they sell. ARCs can also have their club name or logo printed onto these shirts. All shins come with a 30-day no questions asked guarantee. T-shirts are priced at $14.95, sweatshirts $26.95 plus S&H (CA residents add 7.75% sales tax). For more information or to order contact *Raymond Sarrio WB6SIV, 6147 Via Serena St., Cucamonga, CA 91701; (orders) (800) 413-1129, (info) (909) 987-1020.* Or circle Reader Service No. 205.



RF INDUSTRIES

With RF Industries' new Unicable Kit, you can now mix *and match* any combination of connectors or adapters to the ends of a 48" cable assembly. Covered in a soft PVC matte blue jacket with matching molded strain reliefs, these cable assemblies are flexible and easy to handle. This extra flexible RF-58A/U type 50 ohm cable with 95% double shielding (tinned copper braid over aluminum foil) is 48" long. Unidapt universal connectors at each end feature machined brass, silver plated bodies, gold plated contact, and Teflon dielectric insulators.

Frequency range is DC to 1 GHz; impedance is 50 ohms; insertion loss is less than .2 dB; and VSWR max is 1.2:1 from DC to 1.5 GHz. For more information visit your local dealer or contact *RF Industries, 7620 Miramar Rd., San Diego, CA 92126; (619) 549-6340, (800) 233-1728, FAX (619) 549-6345.* Or circle Reader Service No. 207.

PROPAGATION

Number 26 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

Well, three out of four weekends ought to be pretty good this month, while the only one expected to be POOR is the 21st and 22nd (third weekend). Weekdays ought to be FAIR to GOOD *except* the 11th through 13th. Really GOOD days ought to be the 4th, 5th and 6th, as well as the 29th, 30th and 31st. Of course, that's not a promise, but pretty close to it! Look at the daily forecast for your planning, and enjoy the holidays.

If the pundits are correct, 1995 could well be the year in which Cycle 22 bottoms out, and if so I expect the low conditions to extend for almost a year . . . sort of a low plateau of sunspot numbers. Naturally, I hope I'm wrong. Tune WWV at 18 minutes after any hour for up-dates on propagation.

10 and 12 Meters

Only occasional F2 openings to the tropics on GOOD days during daylight hours. Not much sporadic E or short skip propagation can be expected. Skip is where you find it, so keep looking and hoping. Sometimes results are spectacular on a supposedly "dead" band. Really good "gain" antennas can help a lot this month. A good local band.

15 and 17 Meters

Fairly good DX into the Southern Hemisphere during daylight hours from noon to sunset *local* time, and short skip from sunrise to sunset, but expect the band to close soon after—abruptly!

20 Meters

Daylight hours should be pretty good for DX this month in spite of depressed conditions in general, and you may even find the band open until midnight. Peaks ought to occur just after sunrise and late afternoon *locally*. If the band does stay open after dark, look for openings into South America and even Antarctica. Also, during the day, you will find considerable short skip. All of which means that 20 meters should be your PRIME DX BAND. (See 80 meters, too.)

30 and 40 Meters

Expect late afternoon and evening openings into Europe and Africa swinging south after sundown for a few hours, but the MUF falls below 7 MHz later in the evening. Short skip will occur during most days out to 1,000 miles or so, and to 2,000 miles at night until the band closes.

For you newer operators who have not lived through a complete sunspot cycle, there will be some great surprises in store. Listen and learn.

80 Meters

This will also be a very good DX band after dark, and since QRN is low, signals ought to be very readable . . . even weaker ones. Peak DX occurs around midnight local time and just before sunrise. Insomniacs will *love* 80 meters this month. Short skip at night will occur frequently out to 2,000 miles. Isn't it interesting how two of our "oldest" bands, 80 and 20, are the best in these times? The old-timers knew what they were doing when they "got" these bands for amateurs way back when.

160 Meters

You "top band" operators will love this band in December: DX openings to the east from your locations, peaking around midnight (Europe, etc.), and toward the south and west before sunrise. Nighttime short skip should also be good from dusk to dawn, getting longer later. On this band, use vertical antennas to transmit and horizontal antennas for receiving, preferably Beverage antennas if you have the room. Low noise and minor static will make you happy. 73

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
AGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15*	15*
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15*	15*
INDIA	20/40					20	40*	20*				15*
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40*	40*				15	15	15	20	20
USSR	40	80	80	40			20	20	20			40
WESTCOAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	80	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15*	20*	20*				40*	20*	20			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
USSR	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40*	40*							15	15	20
USSR		40*	40	40*	40*				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

1=May be open only once or twice during month   *=Try next higher band   G=Good, F=Fair, P=Poor

JANUARY 1995

SUN	MON	TUE	WED	THU	FRI	SAT
1 G	2 G-F	3 F-G	4 G	5 G	6 G	7 G-F
8 F-G	9 G-F	10 F-P	11 P	12 P	13 P	14 P-F
15 F	16 F-G	17 G	18 G-F	19 F-P	20 P	21 P
22 P	23 P-F	24 F-G	25 F-G	26 G-F	27 F	28 F-G
29 G	30 G	31 G				

BARTER 'N' BUY

Number 27 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rt. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the March 1995 classified ad section is January 6, 1995.

FEBRUARY 1995
ISSUE # 413
USA $2.95
CANADA $3.95
A WGI Publication
International Edition

73 Amateur Radio Today

Grounding & Lightning Protection
A Special 2-Part Series

Build a Bi-Square Loop

Inexpensive Dual-Band Yagi

Read Morse with your PC

More 73 Reviews

Down East Microwave Transverters

Radio Shack DSP-40

Sentech 2m Quagi

Midland Base Antennas

Yaesu FT-900

THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

MANAGING EDITOR
Hope Currier

SENIOR/TECHNICAL EDITOR
Charles Warrington WA1RZW

EDITORIAL ASSOCIATE
Joyce Sawtelle

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Charles Warrington WA1RZW

GRAPHIC DESIGN
Suzanne Self

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

GRAPHICS MANAGER
Linda Drew

CIRCULATION MANAGER
Harvey Chandler
To subscribe: 1-800-289-0388

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-289-0388

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

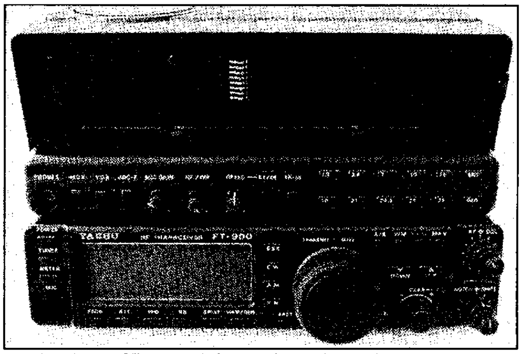
73 Amateur Radio Today

February 1995
Issue #413

TABLE OF CONTENTS

FEATURES

REVIEWS



The Yaesu FT-900 with front subpanel detached and resting below the main radio body. See the review on page 10.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: A sky view of the satellite antennas at the recent AMSAT Space Symposium in Orlando, Florida. (Photo by George E. Caswell Sr. K1MON.) Inset: Rob KD6EWT, age 12, operates the new Yaesu FT-900 in real contest conditions. (Photo by Steve Katz WB2WIK/6.) One-year subscription extensions go to each of these photographers in the ***73 Photo Search.***

FB

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents ©1994 by Wayne Green Inc. No part of this publication may be reproduced without written permisson of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: A picture is worth a thousand words, but a good picture is worth a year of *73!* You are therefore ordered to take your camera with you and capture a fine ham radio photo to grace an upcoming issue of your favorite magazine. Enter the *73* Photo Search today!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Odd Coincidence

The next time you're short of things to talk about on the air . . . like probably your next QSO . . . there's something that'll get you some attention.

First, a little background. Last month I wrote about lile vs. matter. I've always been interested in anomalies, so I've got quite a library of books about odd things that have happened. Such as the books by Charles Fort and Frank Edwards. I've got shelves of UFO books, books on reincarnation, ESP, past lives, out of body experiences (OBEs), near death experiences (NDEs), psychics, and so on. All of these fields have been carefully researched, so if you categorically think the whole business is hooey, it's because you haven't done your homework. It's easy to be sure of something you know little about.

One of the scientists I met at the Maui cold fusion conference was Dr. M. Srinivasan (Chino), the Associate Director of the Bhabha Atomic Research Center In Bombay. Since I'd met another Dr. M. Srinivasan at a subtle energies conference a few months before, I wondered If Chino was any relation. The first one had asked me to critique his book on *Earth Energies*. Nope, no relation.

Chino Is on the *"Cold Fusion"* magazine board of scientific advisors, so I've been keeping In touch with him. He sent me a copy of a newspaper series he'd written about extra-sensory perception of nuclear structure and atomic particles.

A hundred years ago people were much more interested in psychic phenomena than they are today. Ouija boards and seances were common. We tend to laugh at all that nonsense now, chuckling at the naivete of the 19th century, but that's only because so few of us have read the literature.

In 1895, one hundred years ago, Annie Besant and C.W. Leadbeater clairvoyantly observed and documented in detail the structure of all 92 naturally occurring elements, right down to the sub-quark level, Including isotopes. The two were eminent theosophists and authored dozens of books on subjects such as life after death, reincarnation, and the astral plane.

It was these two people who discovered Jiddu Krishnamurti when he was 12 years old and predicted he would grow up to be a world teacher. I've read many of Krishnamurti's books and attended his lectures, so I know what an incredible person he was.

Besant and Leadbeater started with hydrogen, the simplest element. They found that it was made up of 18 subatomic particles which they christened Ultimate Physical Atoms (UPAs). They reported that the other elements were made up of the same subatomic particles, but whose numbers increased in multiples of 18. This was done well before Rutherford discovered the atomic nucleus in 1911. In the 1920s the Bohr-Schrödinger hydrogen model had one proton with one electron orbiting around it. There was no way for there to be 18 particles in the hydrogen atom, much less the 4,267 particles the clairvoyants had counted In a uranium atom.

Of course, In 1963 Gell-Mann and Zwelg discovered that the proton and neutron are each made up of six quarks, each of which is made up of two types of three smaller sub quarks, 18. I'm currently reading Gell-Mann's recent book, *The Jaguar And The Quark*, which is fascinating. Look for It.

A trained Yogi can see hidden, small or distant things. He can not only magnify (micro-psi) things, but can slow down their action. In 1991 a Canadian, Ronald Cowen, who had been practicing meditation for several years, when he read about this, tried it out and found that he too could visualize Micro Physical Atoms (MPAs) and their UPAs. Cowen went on to do something even Besant and Leadbeater hadn't been able to do, he provided a description of the structure of a single electron.

Besant and Leadbeater spent years clairvoyantly examining all of the elements. They found that by dividing the number of UPAs by 18 they arrived at the atomic weight for each element. They discovered that several elements had two sets of UPAs, and this was five years before Aston's discovery of isotopes in 1912. They were surprisingly accurate in their estimates of atomic weights and their placement in the periodic chart. They even discovered five elements which were unknown to science at the time of their work.

Their drawings of the UPAs (subquarks) are surprisingly similar to those in a pre-publication edition of a book James Carter recently sent me on his proposed new model of atomic structure. These UPAs seem to be made up of toroldial-shaped spinning helixes of energy. They counted spirals or whorls and found there were seven levels of them. The first layer had 10 whorls. Each of these were made up of 1,680 turns of helical coils, and so on down for at least seven levels of abstraction. Coils made out of coils, made out of coils.

This configuration was confirmed in 1992 by Cowen and reported S.M. Phillips. An earlier micro-psi researcher, Edwin Babbitt, published a book In 1878 which showed a diagram that looks much like the UPAs of Besant and Leadbeater. When you consider that the latest theories on protons and electrons is that they are actually tiny vortices of some sort of field, and not particles at all, you can see why the clairvoyants have had a problem describing what they've seen. And how amazingly accurate their descriptions have been.

Now, how did these clairvoyants manage to visualize and describe atomic structures which scientists have had to use enormous cyclotrons and Van Der Graaff accelerators to view? Can you see why I've been urging researchers to look into the power of the mind? It appears that this is a tool which can be used to investigate not only the micro-universe, but also the macro . . . as well as helping us to learn more about life itself . . . and death.

I suspect that no American scientist would never dare to publish such an article. He'd be ridiculed by other scientists for even suggesting that the work of Besant and Leadbeater was anything more than just lucky guesses. Micro-psi, Indeed! Buncha crap. Loony. Crack-pot.

Well, as I've mentioned before, since getting involved with cold fusion I've been excited to meet as many respected scientists as I have who do have open minds. These are truly exciting times.

My Frustration

When I give talks at hamfests and conventions I often ask for a show of hands. How many of you are involved with working DX? Contests? Home construction? How many have been on a DXpedition? How many are active above 450 MHz? How many on RTTY? Packet? Slow-scan? Foxhunting? Satellites? And so on through the major ham activities open to us.

The discouraging part is the pitiful showing of hands. One, two . . . often none. What does it take to get you off dead center? Here we are in the middle of an extravagant banquet and you are nibbling a cracker. Even those who are devoting what's left of their lives to rag-chewing aren't talking about anything much. The rig here is . . . blah, blah. Hell's bells, read some books and make your contacts interesting.

When I write about the interesting things I've done in amateur radio I get tagged as a braggart and an ego case. All I'm trying to do is get you off your duff and into life. I'm busier than all hell, yet somehow I've managed to work seven states on 10 GHz. I've worked 100 countries on 20m in one weekend. I've DXed from Nepal, Lesotho, Swaziland, New Caledonia, and Sabah. And if you think all this takes big money, you haven't bothered to read my books. It doesn't cost much to do things, it just takes some determination.

I've had a ball on RTTY, on packet, on slow-scan, and so on. Well, I want to somehow goad you Into sharing the fun I've had. I love good music, so I've been doing my best to get people to enjoy it with me. I wish you could see the letters I've been getting from people thanking me for my Scott Kirby ragtime CDs. Scott has turned into a giant in ragtime. And the piles of mail thanking me for the over a hundred sampler CDs I've produced. I also get letters thanking me for putting readers onto some of the more exciting books I've read.

Yes, I go to the movies about once a week. And I watch some TV too. But mostly I read, write, and try to keep my many businesses going despite occasional treachery by trusted assistants. I'm not on the air as much as I'd like, but that's your fault. When I do get on I quickly get bored with routine QSOs. 90% of the chaps I run into on 20m seem to be retired and doing nothing further with their lives. I want to know what they've read recently that I'd enjoy. I want to know what they've done lately that I might enjoy. It wouldn't take a lot of push to get me involved with sky diving, ultralites, and things like that. If someone opens a new area for ham adventure, I'll be out there in front.

Instead of pioneering we're all wrapped up with homosexuals suing the League to force them to run ads in *QST* soliciting members, with seeing who can be the most loathsome on

Continued on page 75

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Jose L. Rivera KP4FMD, Orlando FL We couldn't believe our eyes when we saw our photograph on the cover of your magazine (November 1994). This was really a wonderful surprise. My wife and I would like to thank the *73* Photo Search committee for taking the time to examine and select the picture.

Thanks for the extended subscription, and the best of luck.

Cleve Svetlik K8NZV, Pepper Pike OH Wayne, this letter has been years in coming. Following your advice, I became involved in politics on a local level about 20 years ago, which has eaten up a lot of my free time. I do feel that I have been able to make a difference in our community, and above all, I have found the experience to be gratifying.

It was a lot of years ago when I first met you personally at your apartment in New York City, where I first subscribed to *73*. I felt then, and continue to feel, that you are one of the few people who recognize the big picture when it comes to government and its relationship to amateur radio privileges. If the Feds really wanted to, they could wipe out the amateur service and sell the frequencies to the highest bidder. Oh, they would not do it in one fell swoop, they would just continue to nibble away at the frequency allotments until nothing is left.

Selling frequencies is a rather new concept. The Federal Government cannot get enough money from the poor taxpayer, so they have gone to selling frequencies to bolster their income. In a similar vein, OSHA has raised their fines again and again under the guise of safety to help cover the cost of their agency. One can wonder what is happening to all the money taxpayers send to Washington. I thought it was for running the government.

One would hope that the ARRL would be a positive and strong force representing amateurs, especially in our relationship to the Federal Government. As you have so ably pointed out over the years, such is not the case. An effective ARRL would include the principles of fighting for every possible frequency, every possible mode of operation, and the absolute minimum of requirements and restrictions to obtain a license. Instead, we got incentive licensing and more restrictions. As you so ably put it, past ARRL actions have almost killed the hobby.

Some of the hams I talk to still hold the myopic view of requiring stiff code requirements to obtain a license. They don't want to hear the arguments that code is only one method of communicating. They also don't understand (or even think about or use) any of the computer-based systems or satellites, and never intend to. So . . . let them be. Let them have their own frequency assignments for CW. But do not let their opinion regulate other hams who wish to communicate using different modes, and above all do not let such people dictate stiff code requirements for others who wish to obtain a license but for whom the code requirements are a stumbling block. It is unfair, unjust and discriminatory. There should be room for everybody in our hobby.

Wayne, in my work as a consulting engineer I come into contact with many electrical and computer engineering folks. I get to know many of them personally since our projects tend to require many visits before the job is completed. I usually ask if they have had any interest in amateur radio, and many times I get a positive response. Over 90 percent of those who showed interest but did not obtain a license indicated that the code requirement was the reason why they turned their back on amateur radio. Since the advent of the no-code license, of the few people I have talked to, the inaccessibility of the lower frequency bands dulled their interest. We need these people.

Wayne, please keep the pressure on to get rid of the code requirement, or at least reduce it to 5 wpm for General Class. This can do nothing but help our hobby.

Cleve—Ah, the synchronicity of Great Minds. My November 1994 Radio Fun *editorial proposed that the Tech-Plus ticket be grandfathered to General.*

With the diminished relevancy of CW, there would seem to be no further need for the 13-per skill obstacle. This would reduce the cost of licensing and speed it up at a time when the FCC has fallen seriously behind in issuing licenses. It would also simplify (lower the cost) of monitoring and enforcement.

The entry of 175,000 new General Class licenses to the low bands would generate a needed growth of the amateur radio industry. The ensuing increase in activity on the low bands would, in turn, encourage the development and pioneering of more frequency-saving technologies and practices.

The increased interest in activity would tend to attract more newcomers. With there being a direct connection between technology and gross product, this would tend to attract more youngsters to high-tech careers, and thus increase America's ability to compete with other high-tech countries. . . . Wayne

Steve Katz WB2WIK/6, Chatsworth CA Wayne, I read your editorial in the December 1994 issue of *73* (I always do) and must agree that while you're hitting the nail squarely on the head, most seem to be missing the message regarding America still being the Land of Opportunity. You suggest that folks do something they like to do anyway, get really good at it, and then reap the profits. Know who the real experts are at this? The professional sports players. Most of 'em would be playing their sport out on the street, anyway, if they couldn't find professional employment. the really good ones make millions of dollars a year to do something they like to do, anyway. Perfect example of hobby becoming profession.

I love basketball but lacked the necessary physical attributes to achieve a professional level of play when I was young enough to pursue it; now I'd do better, but I'm too old. So, that one's out. Photography is another of my hobbies, and I have lots of great equipment already . . . nah, too many shutterbugs out there. Competition's too fierce, and a lot of those guys are really good. I like to ski, but not well enough to compete or teach. So much for that one. Swimming? Yep, I'm real good at that and did have professional instruction from an ex-Olympian as a kid. I've taught swimming before and it's fun. Nah, the kids don't listen and the grownups already have such bad habits. It doesn't pay well enough for the aggravation.

What about—gasp—ham radio? Can't make very much money instructing beginners. It's illegal to charge more than the FCC-prescribed fees for testing. Hmmm. Gotta be a way. How about doing ham-related stuff that nobody else wants to do? Wow!

I started a business assembling and installing antennas and towers for hams. Ya know, doing it right, so things really work and stay up for decades, not months. After 28+ years of hamming and installing my own towers and antennas at a number of sites, I ought to be qualified for this one. OK, to be legit you need a contractor's license. What's involved there? Five years minimum field experience and taking a test. I walked into the test session without a clue as to what would be on the exam—passed first try. Proved the "experience" portion by providing photocopies of invoices and payments received for similar services. I'll be darned, a contractor's license is no obstacle at all.

I advertised mostly by word-of-mouth and became booked solid for months. Working in my spare time only and charging $50 per hour (the going rate), I made enough money to support the hobby for the next century. I expanded by selling leftover goods from antenna installations at the local swap meets. This reduced inventory costs to nothing, and sold almost all materials at a profit. Gosh, this isn't hard. I started a second business as a legitimate distributor by obtaining a business license, registering with a Fictitious Business name. A tax resale certificate is free from the state Board of Equalization, and the forms take all of five minutes monthly to complete and mail in. So, when is being in business going to start being complicated?

As you know, being in business isn't complicated at all. The waters get muddy when you start hiring people, paying benefits and so forth. But if one can run a business single-handedly (or make it a family venture by involving the wife and kids), there's nothing to it. Many businesses don't require a storefront.

With the economy in the sad state it is, the aerospace and defense industries laying off almost everybody, our unfavorable balance of trade and monetary exchange rate with Japan, and the real estate market almost collapsing, no time is better than today to start a small business. I run businesses in my spare time only and keep a regular job, too, mostly for the benefits a large employer can provide (group health insurance, for one!). But if my efforts take off as I hope, I'll be able to provide my own benefits without relying on any outside employment, and make more money than any "regular" job could possibly pay.

Ham radio affords us unique opportunities to advertise for free, if we're discreet about it. Example: Joe Ham is on the air discussing his dilemma of how to install a tower on his lot without his neighbors seeing cement mixers and backhoes going back and forth, raising a lot or curiosity and Ire. I have a possible solution. I call Joe and say, "Gee, I might have the way to solve your problem. If you'll give me your telephone number, I'll call you to discuss it." I get the number, make the call, and propose my services or fees were made on the air. But the *opportunity* for finding clientele surely exists, and it's free. The "sale" still needs to be made in person or on the landline, but the customers are out there on the air every day.

Of course, we can always write magazine articles. (Don't know if you've noticed, but I've had a few dozen published in *73* and *RF* over the past couple of years.) Writing for the hammy mags isn't complicated. All you need is an idea and a sharp pencil. I found some great deals on surplus commercial, lab-quality test gear (Hewlett Packard, Tektronix, General Radio, etc.) and started assembling my "home lab" years ago. Great way to test out new gear on the market and write product reviews. Once you're published in a few of the ham journals, it's easy to get published in professional journals as well. Some of them even pay pretty well for manuscripts (although some don't). My first manuscript, written when I was 14 years old, was published in *73*. That was back in 1966. Since then, my stuff has been accepted by *TV Guide*. Not bad, eh?

Anybody with a lick of initiative can make a business providing services for ham radio operators, and it needn't stop there. If you're good, word of mouth will take over and you'll be getting calls from non-hams. After being in my little business about six months, I started getting calls from CBers, scanner listeners and other SWLs, and even non-hobbyists who wanted TV antennas installed. Then, calls started coming in from public service agencies, police and fire departments, repeater/paging system owners, and then from Kenwood Communications in Long Beach, who wanted new antennas installed for their service department. I've literally had to turn away business, there's just too much of it.

Maybe if you use some of us who have succeeded in making a business from ham radio as examples (I'm sure you've heard from others!), the message would finally get through.

Capitol Ham

David Funderburk K4TPJ is among the newest members of the United States House of Representatives. Funderburk is not only an amateur—he also holds a PhD and has taught history at several North Carolina colleges. The 50-year-old Republican served as U.S. Ambassador to Romania during the Reagan years.

Funderburk describes himself as an "avid amateur radio operator," and holds a General Class ticket. He represents North Carolina's 2nd Congressional District. *TNX Florida Skip, Vol. 36, No. 12, December, 1994.*

Tech Minus

Due to an apparent miscue at the FCC, a lot of Technician Plus amateur operators have been issued licenses which do not reflect their code privileges. If you earned your Technician Class ham ticket before March 16, 1987, you are automatically a Tech Plus—meaning you also passed a code test.

But the Commission's computer has coughed out an undetermined number of licenses without the Plus designation. If you could fit into this category of operator, perhaps you should take a closer look at your license.

If you were shorted the Plus designation, write to the FCC explaining the situation. Include information on your current license status and effective date. Send a photocopy of your license with the letter. Address it to: *Federal Communications Commission, 1270 Fairfield Road, Gettysburg, Pennsylvania 17325-7245; FAX (717) 337-1541.* The Commission advises it will take from four to six weeks to process the correction. *TNX KC6IJE; Palo Alto Amateur Radio Association's "PAARAgraphs" newsletter, December 1994.*

Band Changes Proposed

The FCC has adopted a Notice of Proposed Rule Making to convert a block of spectrum from federal government to commercial use, including two UHF bands currently available to amateurs on a secondary basis with the government. The proposal calls for reallocation of 2390-2400 MHz, 2402-2417 MHz, and 4660-4685 MHz to fixed and mobile commercial use. (A 4660-4685 MHz change would not affect amateurs.)

Under the Omnibus Budget Reconciliation Act of 1993, the FCC is required to adopt rules for such a move by February 10. A number of responses to the proposed changes have been received by the Commission, including many from the amateur community. *TNX Dayton Amateur Radio Association's newsletter "RF Carrier," December 1994.*

Dial Defense Surplus

Interested in restocking your ham shack with Department of Defense surplus property? A new toll free number has been instituted to make it easier. Simply call (800) GOVT BUY (800-468-8289).

The DOD Surplus Property Sales Program is managed by the Defense Reutilization and Marketing Service, a field activity of the Defense Logistics Agency, and is authorized to sell government surplus stuff. Not just ships and tanks, mind you, but office equipment, sporting goods, furniture, tools, nuts and bolts, and clothing, to name just a few.

The information is free, but be advised that a lot of this surplus is sold by auction and "as is." Still, with the government shutting down bases at a record clip, surplus is piling up as never before, and may be worth looking into.

Distinguished Service

The Quarter Century Wireless Association has bestowed the coveted Distinguished Service Award on Kenneth M. Miller K6IR (see Photo A). The award was given at the 1994 QCWA National Convention at El Paso, Texas. This award recognizes Miller's engineering accomplishments and his leadership of the Radio Club of America Scholarship Program.

Mr. Miller's professional career has spanned over four decades and three continents. He has served as an executive with Lear Jet, Motorola, American Standard, The Singer Company and others. Nice work Ken!

The Electronic Way

The FCC has released a seven-page order amending its rules to reflect what it calls "non-substantive procedural changes." Among these changes, the Commission will now permit electronically-filed license application data from VECs, although paper applications will continue to be accepted.

Also new is the following: To authorize operation as soon as the new license data appears in the new amateur service licensee data base, rather than the current system of waiting for the license document to be delivered. Details of how this will be implemented are upcoming. The "Technician Plus" designation will now be treated as an official license class. The Commission also plans to mail a shorter license renewal form to amateurs in advance of their expiration date. *TNX Badger State Smoke Signals, December 1994; ARRL.*

Update

In January's "QRX" column Dr. Karl Meinzer of the AMSAT Phase 3-D International Satellite Design Team was mentioned with the wrong callsign. Karl's call is DJ4ZC. Sorry for the mix-up.

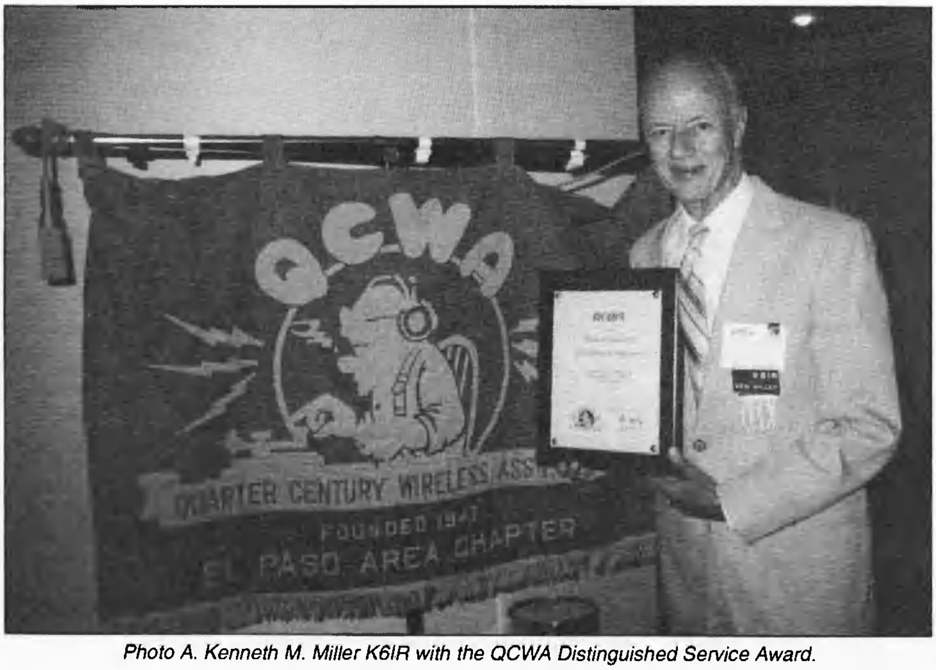


Photo A. Kenneth M. Miller K6IR with the QCWA Distinguished Service Award.

Number 4 on your Feedback card

73 Review

by Steve Katz WB2WIK/6

The Yaesu FT-900AT HF Transceiver

Yaesu U.S.A.
17210 Edwards Rd.
Cerritos CA 90701
Telephone: (310) 404-2700
Price Class: FT-900—$1,499;
FT-900AT—$1,699

Base station performance from a compact mobile rig!

When given the opportunity to try out the new Yaesu FT-900AT for a product review, I thought, "Neat! This is a rig I thought about buying anyway—and now I can try one out before I do!" In early November 1994, FT-900AT serial number 41040690 arrived on my doorstep. By the end of that same day, I had already made 41 contacts with the little rig and had a pretty good feel for it, despite not having opened the Operating Manual at all! That's what I call "user friendly."

Overview

The FT-900AT is about as full-featured an HF rig as there can be in such a tiny box: Measuring only 238 x 93 x 253 mm (9.37 x 3.66 x 9.96") (W x H x D) and weighing only 5.3 kg (11.66 lbs.), it packs "base-station" performance into a mobile-sized radio. The FT-900 and FT-900AT are identical, except that the "AT" version includes a built-in automatic antenna tuning unit, the Yaesu ATU-2 (which can be added to the '900 in the field); however, the '900AT, which has the tuner "factory installed," costs a bit less than buying the two units separately. All discussions herein, except those specifically pertaining to antenna tuner performance, apply to either model.

The rig features a general coverage receiver (100 kHz through 30 MHz) and all-mode operation (CW, SSB, AM, FM, plus SSTV with outboard converter and digital modes with outboard TNC), delivering 100 watts PEP output power (within the ham bands only) from its sturdy, well-cooled transmitter. Output power is adjustable by a front-panel control down to approximately 1.5 watts for honest QRP work. Frequency tuning is accomplished by a large, easy-to-handle, rubber-coated VFO knob, or by pushing "up" or "down" buttons on the supplied push-to-talk microphone. The main display panel contains all the information needed to understand every critical control setting, with a large, easily-read LCD display of operating frequency. The features will be covered later in more detail, but the most significant feature, which differentiates the FT-900 from its predecessor FT-890, is the rig's removable front subpanel. The '900's front subpanel, containing the most-used controls and microphone jack, disconnects from the radio's body with a push of one button ("click") and can be remotely located anywhere within about 19 feet of the radio itself, greatly simplifying mobile installation.

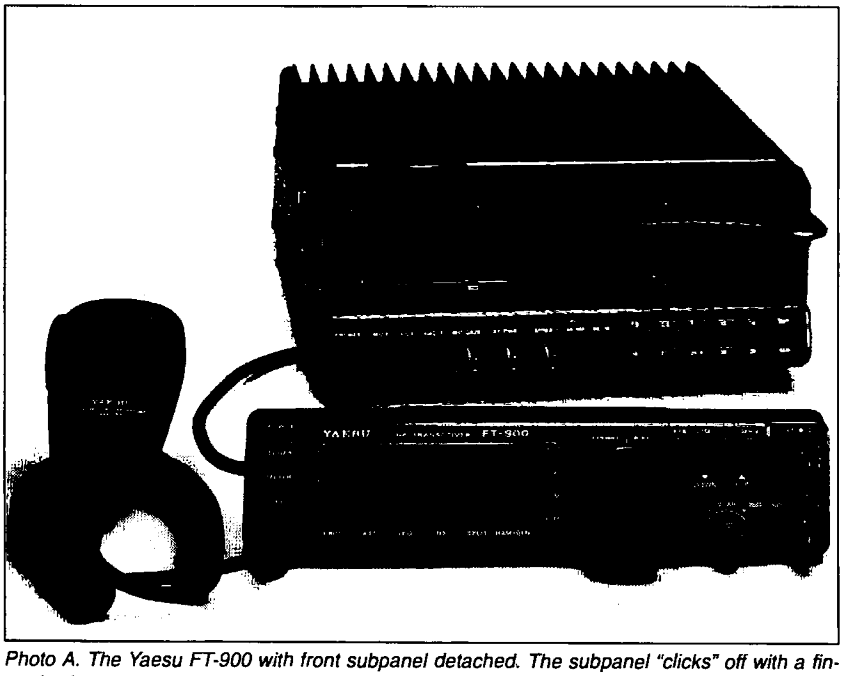


Photo A. The Yaesu FT-900 with front subpanel detached. The subpanel "clicks" off with a finger latch.

Opening the Carton

Impressive is the only word that describes Yaesu's excellent packaging job. Not only are all parts well-protected (the subpanel is packaged separately from the radio's body, giving the new owner an opportunity to try the panel's "mount/dismount" feature almost immediately), but Yaesu thoughtfully includes a world map showing updated amateur radio DXCC countries and prefixes, a large Yaesu decal (bumper sticker?), all the plugs required to put the radio into immediate service, spare fuses, a long DC power cable (dual-fused) and an excellent, easy-to-use, 50-page Operating Manual, complete with schematic diagrams. On the plus side for Yaesu, the manual is great. The "Operation" section contains a "Getting Started Tutorial" (2-1/2 pages) which offers sufficient information to get on the air and start using the rig to its fullest, without having to read through dozens of pages of babble. On the minus side, the FT-900 manual, like most of those from the Japanese manufacturers, offers no hint of any circuit descriptions, theory of operation or a technical troubleshooting guide. Unfortunately, this is the norm for modem rigs from JA-land, so I'm not singling out Yaesu when I complain; the only manufacturer who provides essentially a complete "service manual" right within their normally-supplied operating manual is Ten-Tec (an American company).

Controls

When I first acquire a new piece of gear, I like to see if I can make it work without opening the instruction manual. I won't even buy computer software that requires a substantial time investment in training, as I'm old-fashioned enough to consider it unreasonable for me to spend money on products that will take more time to learn than they could save me in the short term. The FT-900AT passed my test: I completed two log pages full of QSOs on both SSB and CW before I turned to page 1 of the book. Bravo! All ham equipment should be this easy to use.

The front subpanel controls are clustered for easy use. The TUNER switch both activates the internal ATU for use (momentary press) and operates the ATU (longer press, same button). Hooray! No reason to use two switches when one will do. The POWER switch is a "soft-start" type with electronic time delay: A quick press neither turns the rig ON nor OFF. The switch must be depressed for about a half-second to toggle the POWER function. The MAIN TUNING knob has a great feel, and adjustable "drag" using a hidden setscrew. The DISPLAY screen has a warm orange glow with dark gray alphanumeric segments, and is easy to read in almost any

lighting. It displays MODE; filter selection (NAR); GENeral coverage selection (as opposed to "ham" coverage); VFO status (A, B, or SPLIT); FAST tuning mode; dial LOCK; TUNER status (WAIT appears while tuner is searching); HI SWR indicator (if mismatch is too severe for the ATU to find a match point); operating frequency displayed to 10 Hz resolution with separate decimal point indicators; +/- offsets for RPT (repeater) mode; memory SCAN and CHECK status; CHannel number (01-99); MEMory status (V/M, V>M, M>V, and M TUNE); a CAT (computer aided transceiving) indicator; as well as a multisegmented bar graph S-meter and ALC/SWR (switchable) meter. (The S-meter always operates, displaying received signal strength or transmitter power output power; the other bar-graph display switches between ALC, SWR and "off," using the METER switch.) Whew! You think that's a lot? Just wait.

Photo B. The FT-900 subpanel installed in the author's car using Velcro strips. For permanent installations you could use a gooseneck accessory fixture instead.

The removable subpanel also contains volume (AF) and squelch (SQL) concentric controls; IF NOTCH and SHIFT concentric controls, with a center-detent on the SHIFT control and a separate switch for the NOTCH function; DOWN and UP push-buttons for stepped frequency tuning; VFO and memory function push-button keys (as described above under "memory status"); a FAST tuning push-button (a multipurpose key for fast frequency changes using the dial or the UP/DOWN keys—and also serves for making 11 different "FAST" set-up adjustments); mode keys (SSB, CW, AM, FM); and four LED-lighted keys for the speech PROCessor; receiver ATTenuator; receiver preamp bypassing (IPO); and noise blanker (NB). The CLARifier control, with its separate on/off switch and indicator, serves the same purpose as an RIT. An LED lighted indicator also serves as a "TRANSMIT-BUSY" light (green when BUSY, red when TRANSMITting). Now you can say, "Whew!"

Despite the quantity of controls on the subpanel (28), the FT-900 is not a confusing rig to operate, especially if you're familiar with other modem HF gear. A proponent of "simple" rigs, I don't like a lot of unnecessary knobs and switches, and I tend to really dislike "function" keys. The FT-900's panel is not cluttered, and there are no function keys. I found it surprisingly simple to use, and the controls are intelligently labeled for intuitive use right out of the box.

Besides the subpanel controls, there are these additional "main unit" front-panel controls, which cannot be adjusted by the subpanel (and thus are "lost" to the user when remoting the rig): PHONES jack; MOX, VOX and AGC-Fast switches; MIC GAIN; RF PWR (xmtr output); KEYER switch and SPEED control; BK-IN (QSK) on/off; and the 12-button keypad used for either direct frequency entry (very handy—just like a "big" rig!) or rapid band changes. I love the direct-entry keypad. My "big" Kenwood TS-850S/AT has it, as have some of my other radios, but this is something not previously found on a smaller, mobile-type transceiver. This is a major product improvement over the otherwise similar FT-890: Once you use direct-entry QSY, you'll find it hard to live without.

If, say, you are on 7238 kHz and want to instantly QSY to 28335 kHz and the latter frequency is not in a previously-stored memory, all you need to do is press ENTer, followed by 2-8-3-3-5, and then ENTer again, and—bingo!—you're there. Much faster than changing bands and dialing around with the VFO. I once paid hundreds of dollars to get this feature as an option for a Collins KWM-380 (a $4,000 rig). Now, it's "free," included in every FT-900.

The front-panel headPHONES jack accepts either stereo or monaural 'phones, and provides audio to both sides either way. The FT-900's rear-panel contains the DC power connector, ANTenna connector, and four less-frequently used controls: VOX GAIN, ANTI-TRIP, DELAY and speech COMPression level adjustments. I don't mind "losing" these controls in a remote/mobile setup, but would prefer to have at least the DELAY control right in front of me when using the rig at home, since this control adjusts not only the VOX drop-out timing for SSB, but also the drop-out delay for non-QSK (semi break-in) CW work, and might require frequent adjustment as one changes his CW sending speed. One more point: The MIC GAIN control is lost when remoting the rig, and I think this is unfortunate. When operating mobile, the MIC GAIN is one control I find myself adjusting quite a lot, depending on background noise (low with windows closed, high with windows open) and operator's voice characteristics. (I "close talk" the mike and speak loudly, so I require a very low gain setting; others like to hold the mike back a few inches—not a good idea when operating mobile!—or speak softly and will require a much higher gain setting.)

The FT-900 does not have a receiver RF GAIN control! I didn't even notice this until Yaesu Service Manager Chip Margelli K7JA pointed it out. I didn't miss it, either: if a receiver has sufficient dynamic range and good AGC, one would very rarely have any reason to turn its RF GAIN down from "maximum." I can't remember the last time I purposely turned down the RF GAIN control on any of my rigs. Good riddance to this control. (Actually, there is just one example of when this control would be useful: When using high-speed CW on full QSK, it is nice to turn the receiver's AGC "off" altogether, turn the VOLUME way up, and use the RF GAIN like a "volume" control. Maybe one in a hundred operators would actually do this. I operate CW 95% of the time, and I haven't done it in years.)

Input/Output Ports

For a small rig, this one sure has a lot of I/O options! I applaud Yaesu's use of standard "RCA phono" receptacles for the following: +13.5 VDC (to power small accessories); PTT (for a footswitch or other remote PTT accessory); TX GND (circuit closes to ground on xmit, to key a linear amplifier); PATCH IN (phone line input for patching); and EXT ALC (ALC connection to a linear amplifier). So many modern rigs place these functions on the pins of weird connectors we won't have handy. "Phono" jacks are easy to use, easy to find, and allow easy use of shielded cables to prevent RFI problems.

Besides those jacks listed above, the FT-900 also contains the following I/O ports: EXT SPKR ("mini" phone jack); DATA IN/OUT (three-contact "mini" phone jack, for TNC connection); TUNER (5-pin mini-DIN jack for the FC-800 external antenna tuner option); CAT (6-pin mini-DIN jack for external computer control of the FT-900); BAND DATA (8-pin mini-DIN jack providing control signals for the FL-7000 linear amplifier; could be used to provide BAND data for other amplifiers as well); KEY (3-contact "mini" phone jack, used for paddle connection when using the internal electronic keyer, or straight key/outboard electronic keyer connection); and DVS-2 (7-pin mini-DIN jack for connection of the optional DVS-2 digital voice recorder). Also on the rear of the radio is the air inlet grill for the automatic forced-air cooling system, and a healthy GND (ground) terminal for attachment to earth ground. Sound like enough for a "mobile" rig? If you're getting the impression the FT-900 is nearly a base station radio, you're catching on. I applaud Yaesu's use of different types of connectors for the various options; there is no way one could inadvertently connect an accessory to the wrong jack—it won't fit. Also, Yaesu provides detailed wiring pinouts for all the connectors, in pictorials large enough to read without a magnifying glass, on page 11 of the standard Operating Manual. And they supply every single connector you might need with the radio. (The only connectors not supplied are those which are prewired onto their unique accessories. If you don't buy the Yaesu accessories, you'll have no need for these plugs.)

The Receiver

There's a lot more to brag about with the FT-900. The rig's receiver employs "up conversion" (the 1st IF at 70.455 MHz is above the tuning range of the radio), like most modern rigs, to allow wide frequency coverage and reduce undesirable images. The 70 MHz 1st IF is shaped by two crystal filters (XF2001, XF2002) before amplification and conversion to the 8.125 MHz "notch" IF or the 455 kHz final IF. The second and third mixers are 3SK131 dual-gate MOSFETs and all injection frequencies are controlled by the rig's "LOCAL UNIT," a DDS system containing four separate VCOs (low-noise 2SK210 JFETs) to tune from 100 kHz through 30 MHz. The narrowest filtering occurs in the 455 kHz IF stage, where two field-replaceable (solder-in type) SSB/CW filters, as well as the 6 kHz AM and 8 kHz FM filters are located. The "standard" 455 kHz IF filters are ceramic, while the narrower-bandwidth optional filters are crystal types.

The IPO (Intercept Point Optimization) switch performs the same function as Kenwood's AIP (Advanced Intercept Point) switch: It bypasses the receiver's dual 2SK125 JFET front end (RF preamplifier stage) and routes received signals directly to the active, balanced (quad of 2SK125s) first RF mixer. This is handy on the

bands below 10 MHz, where signals can be quite strong and the noise figure is unimportant. The ATT (attenuator) switch adds a 12 dB "pad" between the antenna and receiver, but leaves the preamplifier stage active. Using either or both of these controls should eliminate almost any receiver overload situation, but may reduce sensitivity to the point where weaker signals just can't be heard. Unless you live very near a powerful shortwave broadcast station or use large gain antennas on high towers from a home station, receiver overload should not be a problem. (Overload when operating mobile is almost never a problem.) I'd like to see more receiver dynamic range (extended on the high end of the scale) and fewer Band-Aids to patch up inadequacies, but unfortunately the designs and devices required to significantly improve HF receiver dynamic range can be too costly to include in amateur-grade equipment.

The FT-900's receiver noise blanker (NB) operates in the 455 kHz IF and is activated by a single push-button on the subpanel. It does a reasonable job of reducing ignition noise pulses, but does not have any "threshold" or "width" adjustment as some of the more sophisticated base-station rigs do. The main job of a blanker in a mobile rig is to reduce intrusion of ignition noise pulses, and this blanker is adequate. For enhanced noise reduction in base-station operation, you might consider one of the popular digitally-processed noise reduction filters on the market.

The little Yaesu contains two good QRM-fighting tools which work well: The IF SHIFT adjusts the IF bandpass above or below the center of the IF, thus shifting response around the desired signal. The IF NOTCH filter operates in its own 8.125 MHz IF stage and allows adjustment of a steep (30 dB) IF notch within the IF passband, tunable about 1.2 kHz above and below the IF center frequency. Both functions are similar to those found in many modern HF rigs. The standard (SSB) ceramic IF filter is perfectly adequate for most operation. Yaesu offers an optional, sharper, crystal IF filter (XF-110S, $155) with steeper "skirts" (4.4 kHz @ -85 dB or so, compared with the standard filter's response of 4.4 kHz at -70 dB) for those who may benefit from the additional strong adjacent-signal rejection. Both filters have about 2.6 kHz bandwidth at -6 dB, which leads to nice-sounding audio from both the transmitter and receiver in the SSB mode. (See the note below regarding the TS-50S comparison.) There are two optional CW filters available for the '900, the XF-110C 500 Hz and the XF-110CN 250 Hz, which sell for $149 and $155 respectively. I found in using the XF-110C that it is much sharper than the SSB filter, but not nearly as sharp as the 500 Hz crystal filter in my old (1978 vintage) Drake TR-7. (Not that this is a fair comparison: The TR-7 cost over $2,000 16 years ago. By today's standards, it would be a $4,000 rig. And it couldn't possibly fit in my car!)

A feature of the '900's that CW ops will like is the "Reverse CW Sideband" function. This feature, accessed by depressing and holding the FAST button, then depressing CW, activates a special display screen indicating the sideband carrier Injection "side" (U for "upper," L for "lower"). Rotating the main tuning knob allows the operator to revise the injection frequency (U to L, or L to U), thus altering the way stations are tuned in on CW. This can be a good QRM-fighting tool: If the rig is set up for "U"-side injection and you have severe QRM above the frequency of the station you're trying to receive (and within or near the IF passband), you can switch the injection to "L" and make the interference literally disappear. A combination of switching sideband injection, plus using the IF SHIFT control, works well in suppressing interference that would otherwise be impossible to contend with. My four-year-old TS850S/AT has exactly this same feature, and at the time it was introduced was the only HF ham rig on the market to offer this. The FT-900 is the first mobile-type rig I've seen with reversible CW sideband injection, and I hope others will follow. It works!

CW BFO Offset ("Pitch") is also adjustable in the FT-900. The factory default offset is 700 Hz, but if you prefer listening to higher or lower-pitched CW signals, you can alter the offset from 400 Hz to 1,000 Hz. To remind you of the offset you've selected, the CW sidetone produced by the speaker or headphones tracks the offset. In this way, when you tune in a station so his CW "pitch" sounds the same as the sidetone frequency, you are exactly zero beat with that station. The CW BFO Offset is another function activated by a "FAST" button combination: In this case, it's FAST, plus ATT.

The Transmitter

The FT-900AT's transmitter is impressive. It delivers about 100 watts output into a 50 ohm load (see the sidebar for actual test data), and then goes a bit further by delivering nearly 100 watts output into some common mismatches, even without employing the ATU. For example, while the FT-900AT tested produced 100W output into my Bird "Termaline" model 8201 coaxial resistor (a perfect load up to 1 GHz) at 7 MHz, it also produced 100W output into an antenna having a 2:1 measured VSWR, and didn't begin to "drop off" in output power until the VSWR exceeded 2.5:1. Using the internal ATU, the 2.5:1 antenna (a CW-tuned dipole operated at the high end of the 'phone band) mismatch was perfectly corrected, and the output power increased again. I found a similar situation to exist on every band—the transmitter did not fall off significantly in output power until the measured VSWR exceeded 2:1. This is better than many radios I've seen where output power begins falling off rapidly with any mismatch at all. It might allow many users to get along without the optional internal tuner (ATU-2, $239) or the more fancy optional external tuner (FC-800, $429), especially if operation only with resonant base-station antennas is intended.

Perhaps a brief circuit description of the FT-900's power amplifier stage is in order, and will help us understand how the rig seems capable of nearly constant output power over a wide range of terminating impedances. The rig's "100W PA UNIT" appears to develop about 26 dB gain using three cascaded stages: The first PA driver is a 2SC2166 in common-emitter, with slight degeneration and gain peaking by a 3300 pF capacitor across its 2.7 ohm emitter resistor. The PA driver stage is a pair of push-pull 2SC3133s, with emitters grounded and base bias regulation provided by an IC 8V regulator (uPC7808H). This stage drives the final pair of push-pull 2SC2879s via a 4:1 toroid transformer. The final PA's base bias is supplied by a 2SD882 series regulator and is adjustable. The PA's output is fed to the "LPF UNIT' via a 1:16 toroid transformer which matches the 3 ohm collector impedance of the PA to the 50 ohm filter impedance. The LPF UNIT contains six relay-switched low-pass filters: one each for 160, 80 and 40 meters, plus one each for 30/20m, 17/15m, and 12/10m. Each filter is a pair of pi-sections with tuned series elements and slight imbalance to achieve broadband impedance matching. The output from the filters runs through a directional coupler sampling both forward and reflected power. These detector outputs are fed to both the rig's bar graph display and the 'TUNER-CNTL-UNIT" to provide tuning status data.

The +13.5 VDC line to the entire PA unit is relay-switched by a PTT signal, so no bias is provided to the PA stages on receive. Final PA collector current may be measured using a 1 volt full-scale meter connected between two test points (TP4001, TP4002), and 0.5V means 20A collector current. The entire design is robust, and the only changes I would make if drafting it myself would be to eliminate the switching relay (and use solid-state cutoff bias switching instead); adding another set of test points to allow monitoring the individual collector currents of the two final transistors; and making the final stage bias individually adjustable, so that matched pairs of transistors would be unnecessary.

The FT-900 uses a ducted-air cooling system and very large heat sink to keep its power amplifier transistors cool, and its internal fan is thermostatically controlled to operate when needed. I found that a few minutes of transmitting at full power, either SSB or CW, caused the fan to come on. It's quiet enough that you won't notice it when using headphones, and you'd never hear the fan in a mobile installation (especially with the rig mounted in your trunk!), but it might be slightly distracting if operating with the speaker. Yaesu recommends running at reduced power (50W) for continuous-duty modes such as RTTY or FM, especially in hot or humid weather.

Transmitted audio reports were very good, as were reports on keying when using CW. As usual, I got mixed reviews regarding the speech processor (which operates in the transmitter's IF stage): Some stations contacted said the rig sounded better with the processor on, while others said it sounded better with the processor off. This is pretty typical. The rear-panel COMPression level adjustment and front-panel MIC GAIN control do interact a bit, and both are probably best adjusted by listening with headphones on a separate receiver. The ALC level bar graph display is also a handy tool for making these adjustments. The FT-900 does not contain a "monitor" function which allows listening to one's transmitted audio. I'll admit I miss that feature, as I find it handy on my TS-850S/AT and other "base station" radios I've used. With the FT-900 and most other ham rigs, it never pays to adjust the mike gain or compression level so high that the ALC meter runs above its "normal" range. Too much mike gain makes anyone sound bad and increases background noise. Excellent examples of "too much mike gain" can be found on the bands daily, unfortunately.

The FT-900's speech processor has a frequency-shift feature, which allows shifting the IF passband of the transmitted signal in the SSB mode "to customize your signal for your own voice characteristics" (to quote the manual). The processor offset is adjustable from -300 to +500 Hz; a minus sign (negative shift) emphasizes lower-frequency speech audio, while a plus sign (positive shift) emphasizes higher-frequency modulation. Yaesu recommends starting out with a +100 shift, to add "crispness" to your processed speech. This seemed to work fine for me. The adjustment is performed by pressing and holding the FAST button, and then the PROC button. The display then indicates the precise processor frequency shift, which can be adjusted by turning the main tuning knob. To return to normal operation, you just press the PROC button once more. Easy!

Operating

As with most modern digital radios, the FT-900 has a variety of menu functions. I've already discussed a few of the "FAST" setup functions (used by depressing the FAST key plus one other key, while the radio is already powered up). There are 11 FAST button combinations, plus another 11 power-up functions. These are functions activated or toggled in status by depressing one front-panel key or another while turning on the radio. For example, to disable the beeper confirmation tone generator (which beeps every time you depress a front-panel key), just hold down the NOTCH key while turning on the radio. To adjust FM repeater offset ("shift," which has a 100 kHz factory default), depress FM while turning on the radio; this brings up a "shift" display, which can be altered in 1 kHz increments, using the UP or DOWN keys. These are just two of the power up functions. The other nine are similarly useful.

Almost all QSK (electronic break-in) radios can also operate in the "semi-QSK" mode. This is often required when using an outboard linear amplifier, since most cannot support full break-in operation. In many rigs, you must remove a top or bottom cover to locate a switch that activates a relay for keying an outboard amplifier, and from that point forward you've lost full-QSK capability until the switch is returned to the "off" (QSK enable) position. Not so with the FT-900. This rig has such a switch, but it's located on the bottom of the radio and can be accessed through a hole in the bottom cover. No covers nor screws need be removed to enable or disable the amplifier keying relay. You could easily flip this switch a dozen times a day, and not mind it. Another easy adjustment can be made to the sidetone and beeper volume control, which is accessible through a hole on the left side-panel of the rig. No covers need be removed to make this adjustment, either. Very thoughtful!

Another interesting feature of the FT-900 is the RIT "Clarifier" (CLAR) tuning range and operation. The CLAR tuning range is +/-9.99 kHz (a very wide range indeed!) and its tuning steps are adjustable by 2.5, 5.0 or 10.0 Hz Increments. The factory default increment is 5 Hz, which makes the CLAR tune awfully slowly. I immediately changed it to 10 Hz, which makes the control tune faster but still have enough resolution for easy use. The CLAR works independently for each VFO, each band, and each of the 100 memories. It may be turned "on" and "off" by a separate push-button, but the CLAR has no center detent to remind you when you've returned to zero offset.

The ATU-2 automatic antenna tuner works well and is easy to operate. However, the simple circuit (six fixed and two variable capacitors, seven inductors, 14 relays controlled by a microprocessor TUNER CNTL UNIT) can take quite a long time to "find" a suitable match under some conditions. I tried using a 190-foot long, center-fed doublet (fed with 450 ohm "ladder line" and a matching transformer coupling to a long coaxial feedline to the shack) as a test antenna, presenting varying impedances and phase angles to the FT-900AT's antenna jack. On some frequencies, the ATU-2 found a match very quickly, In a second or two. On others, it was still searching after nearly 30 seconds—although even in these cases It did not give up, and did finally find a match point. Thirty seconds is a long time to wait for an automatic tuner, but is still faster than manual tuning. I tried the same test doublet on my Kenwood TS850S/AT base station rig, and it found a match considerably faster on those frequencies that were troublesome for the ATU-2. The TS850's ATU RF circuitry is not terribly different from the Yaesu ATU-2's, so the difference might be in the firmware. In any case, once the '900AT finds a good match, it retains that data in one of its 31 tuner memories which compare tuner settings to operating frequency. If you always use the same antenna for each band, the memories will automatically operate the tuner as you change bands and frequencies and make rapid QSY much easier. However, if you change antennas on each band (say, you use two antennas for 20m, three for 40m, and so forth), the tuner memories cannot do their job. This problem is not specific to the FT900AT; all the ATUs work this way.

The FT-900 contains (standard) a full-featured internal iambic keyer for CW enthusiasts, and it works well. The keyer has dot:dash weighting control, "defaulted" at 1:3. If you wish to change this, you may do so with another FAST function (FAST + IPO brings up a "weighting" display). I found the internal keyer delightful to use, but wish it had storage (memories). Still, not bad for a mobile rig!

Note: A local buddy (Gary KO6GT) owns a Kenwood TS-50 HF mobile rig and we thought it would be fun to compare the FT-900 to the TS-50, considering that the little Kenwood may be the '900's only real competition for the mobileer market. The TS-50 is not available with an internal ATU, and lacks many of the sophisticated panel controls of the FT-900; however, it is a good working radio that has been well-received by mobile/portable enthusiasts, and some even use it as a base station. We set up the TS-50 and the FT-900AT side by side, with a coaxial switch to rapidly change antennas from one rig to the other. While the TS-50 is an excellent product and the envy of many mobileers, the FT-900 was found to be far more functional in a variety of ways. The FT-900's receiver "sounded" better, to quote Gary, who owns a local recording studio and has an educated ear. The '900 has a tighter standard IF filter, making for less hiss and more signal when tuning around the bands. While both radios were more than capable of digging down in the dirt for weak signals on the higher bands (21-28 MHz), signals sounded a bit more readable on the FT-900. In my opinion, this was due to a combination of factors, including narrower IF filtering, different audio frequency response and a better internal speaker which produced louder-sounding signals. (Note that when "remoting" the FT-900, you lose its internal speaker and must use an external one, which plugs into a recessed jack in its subpanel.) On transmit, Gary's TS-50 actually produced more output power than the FT-900, but he had "goosed" his rig up in output power by making internal adjustments, so this was not a fair test. Despite the field adjustment which produced greater transmitter power from the TS-50 into a dummy load, the FT-900AT produced more power into real antennas which were less than perfect. (None of my antennas are perfect. Just like their owner.) It was an interesting comparison. Gary likes his TS-50 but admitted that he'd rather have the FT-900, and if they were both the same price (they're not), the '900 would "win" in his book. My suggestion, as always, is to try out everything, and make a product selection which is best for you.

This Separation Isn't Painful

The FT-900 front subpanel detaches in about one second and the operation involved could easily be handled by my three-year-old (no chance that I'll let her!). To remote the rig from the subpanel, you'll need to purchase Yaesu's YSK-900 Separation Kit, which retails for a mere $56 and includes a 19-foot cable to Interconnect the two, plus a mounting bracket for the subpanel and a set of mounting brackets for the rig's "body." Since the mobile PTT mike plugs right into the subpanel using an 8-pin telephone-type modular plug ("click"—it's in), all you need to add for a neat mobile installation is a speaker (a mini phone jack is in a recessed socket in the rear of the subpanel), and something to mount the subpanel on. Yaesu recommends a gooseneck-type mounting fixture (not supplied), but I think even Velcro strips would work, as the subpanel weighs almost nothing. Yaesu provides a sheet titled "Important Advice on Mobile Installation and Operation," which recommends routing the DC power cable, antenna coaxial cable and subpanel control cable in separate paths (not bunched together in parallel). The DC power cable should, of course, be connected directly to the car battery and not taken from the cigarette lighter or fuse panel. Even following Yaesu's careful precautions, mobile installation should not take more than one hour. I tried it, and had the rig professionally installed in 45 minutes, including routing ail the cables under the carpeting (ugh!) and hanging a mike bracket on the dashboard.

Mobiling with the FT-900AT is a breeze. While mobile whips usually don't load up well across an entire amateur band (especially below 20 meters), the ATU helps generate a powerful signal from even modest antennas like my Hustler system. My first mobile contact with the FT-900AT was with JA1LZR in Tokyo on 17 meters. Joe gave me a "56" report. My next contact, with ZP6CW, yielded a "559" report on CW, also on 17 meters. (Yes, I'm one of those nuts who operates mobile CW.) The best part is: I was using a 20 meter whip! (My Hustler RM-20S was all tuned up on 14.150 MHz and had an SWR of greater than 3:1 at 18 MHz. I used it anyway, and the ATU-2 did its job and got me some DX!)

Options and Accessories

I've already mentioned some of the available options for the FT-900. There are others. The TCXO3, a high-stability reference oscillator for the '900 frequency synthesizer, is available for $95. The DVS-2 digital voice synthesizer, capable of recording from the FT900's mike or from its receiver (playing back other hams so they can hear themselves is kind of fun!) retails for $279. The SP6 base-station speaker is $149. The mobile bracket, if you want to mount the radio as one unit without the separation kit, is $29. A sharper SSB IF filter, model XF100S, retails for $155.

While I would opt for a CW filter (XF110C, $149; or XF110CN, $155) because I work a lot of CW, my feeling is that if you load up on lots of accessories to make this a base station, you might be better off with a real full-featured base station rig like an FT-1000. If a small, mobile-type radio could become a wonderful do-everything base-station, then not many FT-1000's would have been sold. On the contrary, lots of FT-1000's have been sold, and this is one of the choice radios for big-gun DXers and contesters. They know what they're doing.

On The Air!

If you've read this far, you know I like the FT-900AT. It's a very worthy radio that would make a great addition to my shack or car (and probably will). But how does it work in real life, on the air? Just great!

See Table 1 for an honest recounting of what I

FT-900 Measurements

Transmitter:
Rated power output: 100 W (CW, FM) all bands
Measured into 50.0 ohms load (resistive)
VDC = 13.8V

Frequency (MHz)	Max Po (W)	Min Po (W)	Tuner loss (VSWR = 1.0)
1.8	118	2.0	-.34 dB
3.5	110	2.0	-.41 dB
7.0	102	1.7	-.45 dB
10.1	97	1.7	-.52 dB
14.0	94	1.6	-.70 dB
18.1	90	1.6	-.79 dB
21.0	88	1.5	-.87 dB
24.9	80	1.3	-.97 dB
28.0	70	1.2	-.53 dB
29.7	74	1.2	-.91 dB

Measured into VSWR = 2.5:1 (reactive, adjusted phase angle for minimum Pout)
VDC = 13.8V

Frequency (MHz)	Max Po without tuner engaged (W)	Max Po with tuner engaged (W)	increase in Po with tuner
1.8	42	109	+4.1 dB
3.5	70	100	+1.5 dB
7.0	62	92	+1.7 dB
10.1	100	86	+0.0 dB
14.0	60	80	+1.2 dB
18.1	70	75	+0.3 dB
21.0	65	72	+0.4 dB
24.9	60	64	+0.3 dB
28.0	60	62	+0.1 dB
29.7	55	60	+0.4 dB

Power output bar graph display accuracy test: 50 ohm coaxial resistor load
(Data taken at 21.000 MHz, which averaged errors)

Indicated Power	Actual Power
10 watts	12 watts
25 watts	27.5 watts
50 watts	51 watts
100 watts	92 watts

FT-900 current drain from 13.8 Vdc power supply:
Rx only (standby) = 1.4A
Tx @ lowest power output setting (see chart above) = 4.0A
Tx @ standard "QRP' level for Field Day (5W out) = 5.7A
Tx @ 1/2-power output (50W) = 14.3A
Tx @ maximum power output setting, worst case = 22.9A
% Efficiency, RF power output to DC power consumed:
Tx @ lowest power output setting = 3%
Tx @ 5W output power = 6%
Tx @ 50W output power = 25%
Tx @ full output power = 32%

Receiver:
Rated sensitivity: <0.25 µV for 10 dB S/N (SSB & CW)
0.5 µV for 12 dB SINAD (FM, 29 MHz)
Measured sensitivity: 28.000 MHz was "worst case" and all sensitivity data taken at this frequency.
MDS (minimum discernible signal) = -127 dBm (0.1 µV)
10 dB S+N/N ratio = -118 dBm (0.29 µV)
FM sensitivity MDS = -121 dBm (0.2 µV)
FM sensitivity 12 dB SINAD = -115 dBm (0.4 µV)
FM sensitivity "DFQ" = - 87 dBm (9 uV)
Rated selectivity (-6/-60 dB): 2.2/4.2 kHz (SSB & CW wide)
0.5/1.8 kHz (CW NAR, XF110C)
250/700 Hz (CW NAR, XF110CN)
6.0/18 kHz (AM)
8.0/19 kHz (FM)

Measured selectivity: (Note did not measure CW NAR XF110CN response as this option was not installed)
SSB and CW wide: 2.24 kHz, -6 dB; 3.7 kHz, -60 dB; 7.24 kHz "ultimate" rejection (-87 dB)
CW NAR (XF110C): 500 Hz, -6 dB; 2.3 kHz, -60 dB; 5.5 kHz "ultimate" rejection (-87 dB)
FM: 7.8 kHz, -6 dB; 15.6 kHz, -60 dB
AM: Not tested.

Notch filter performance: 37 dB maximum notch (SSB & CW)

S-meter bar graph display accuracy test:
(Data taken at 10.1 MHz, which normalized readings over all the HF amateur bands.)

S-meter bar graph indication	Actual signal strength dBm/µV
SSB & CW readings	
S1	-104/1.4
S2	-103/1.6
S3	-101/2.0
S4	-98.5/2.7
S5	-95/4
S6	-89/8
S7	-82.5/17
S8	-75/40
S9	-67/100
S9+20 dB	-48.5/850
S9+40 dB	-33.5/5000
S9+60 dB	-17/31000
FM readings: Taken at 28.6 MHz	
S1	-105/1.25
S2	-103/1.6
S3	-101/2
S4	-98/2.9
S5	-94/4.5
S6	-89/8
S7	-83/16
S8	-75/40
S9	-67/100
S9+20 dB	-51/630
S9+40 dB	-35/4000
S9+60 dB	-19/25000

Note regarding the FT-900 bar graph output display:
The FT-900 uses a 31-segment LCD bar graph to indicate power output (W) and S-meter readings. This allows very fine resolution for small incremental changes in output or received signal strength and is one of the best bar graph displays reviewed. Its accuracy was equivalent to many of the analog meters found on similar or higher-priced equipment, and of greatest surprise was its "S-meter" accuracy on FM. Most "S-meter" readings on FM receivers, whether the display be analog or digital, are highly inaccurate and might be used for relative indications only; not so with the FT-900, where the "S-meter" readings on FM are almost as meaningful as they are on SSB/CW modes. I wish the VHF/UHF FM equipment makers would find out how to do this! (Data taken by WB2WIK/6 11-23-94)

worked the first day I had the little rig, before I even opened the owner's manual.

The list is actually much longer than this, but you get the idea. I let my nephew, Rob KD6EWT (cover inset photo), a 12-year-old aspiring contester, use the FT-900AT during the ARRL SSB Sweepstakes, the weekend of November 19th. Using the rig "barefoot" with a vertical antenna, and operating only half the contest, he worked 295 contacts In 72 sections, for 42,480 points. He's not much of a phone operator and does better on CW, but he had fun. I asked him how he liked the rig, and his reply was, "Can we buy it?"

Table 1.

10.1 MHz CW:	WZ7L	559 Orem, UT	Steve said it sounded great.
7 MHz CW:	K1TU	579 Houston, TX	Bob loved it.
14 MHz CW:	HI3MTU	599 in Haiti	Quick contact, DX style.
14 MHz CW:	JA2RGH	579 in Aichi, Japan	Aki said "FB radio."
14 MHz CW:	JA1JYZ	589 in Tokyo	Tam liked the keying.
14 MHz SSB:	FJ/K4ISV	58 in French St. Martin	Bud gave good audio report and was enjoying his vacation on the beach.
14 MHz SSB:	N3EUU	57 in Harrisburg, PA	John gave good rpt.
14 MHz SSB:	KB8CQ	59 in Cleveland, OH	Ed liked the audio.
7 MHz CW:	TOØP	599 In Congo QSL via F6BFHI	Worked on first call with pileup.
10.1 MHz CW:	AAØMY	599 in Grand Forks, ND	Foy gave good rpt on sig quality and keying.
18 MHz CW:	7K1LVV	579 in Saitama, Japan	Tohru gave "all OK" on rig.
14 MHz SSB:	K5WUL/M	59 In Richardson, TX	Larry heard me in his car OK, near Dallas—good audio.

Summary

The FT-900 does most things well, and some things superbly. It is not an FT-1000, but then, it doesn't claim to be. It's a well-equipped mobile-portable-Field Day rig that will serve as a good base station for many operators. Small as it is, if you're revamping your station and wish to replace an older-generation HF rig, you're in for a great surprise—the FT-900 will perform rings around many older radios, at a price not much different from the original acquisition cost of the older gear. For mobileers, what can I say? The FT-900 is a bright star shining in the vast darkness created by too-small automobiles and too-large radios. All in all, I loved this rig.

Number 5 on your Feedback card

Dual Bi-Square Loop for HF

Try this easy, low-cost approach on 20 and 2 meters.

by Frank Kamp K5DKZ

This antenna design meets two major objectives. It provides an effective and inexpensive 20 meter gain antenna. It also provides a simple single support to elevate a 2 meter ground-plane-style radiator. Both objectives are realized economically, and the entire system can be erected on an average-sized lot. The minimum lot size required is 70 x 70 feet, with the mast situated in the center of the property. Overall dimensional requirements are detailed in the elevation view of the installation, shown in Figure 1. Only one loop is detailed. The other loop is identical and oriented at right angles to the first one.

This implementation is based on the single bi-loop antenna design described by W7CJB in the April 1979 issue of *73*. While the bi-loop was certainly not a new antenna design even in 1979, the earlier article inspired the use of two bi-loops to serve as a means of guying a lightweight wooden structure needed to support a 2 meter antenna. Since the guy wires were needed anyway, it made sense to use them as antennas on HF.

The dual loops allow four-point guying of the mast and provide four directions of HF coverage. The gain of each loop is approximately 4 dB, and compares favorably with small yagi antennas of much costlier and complex construction. Direction of maximum gain is broadside to the loops. Only one loop is used at any given time, depending on what area is being targeted for a QSO. A single coaxial feedline is used for both loops. Switching between the two loops is accomplished by using the simple "wireless" relay switching scheme shown in Figure 3. The antenna switching relay is mounted on the mast at the feed points to the loops. It is protected from the weather by a plastic housing salvaged from an old Archer-brand mast-mounted TV antenna amplifier. Most any small plastic container could also provide protection. The only caution here is not to attempt a hermetic seal on the container. It needs to be raintight to keep water out, but the bottom should be ventilated to prevent condensation inside the housing.

For output power levels under 500 watts, RG58 coax will work well as a feedline. Since the wire loops also act as guy wires, they should be made from wire that is heavy enough to do the job. As a minimum, hard-drawn #12 copper should be used in the two legs of each loop that carry the full guying load. Note that the wire loops only provide about a third of the material for each of the four guys. The remainder of the guy is made from nylon or Dacron rope. The rope may be tied directly to the wire loops at the proper points or insulators may be used, but don't substitute wire guys for the rope. The 18-foot 3-inch dimension of each side of the loops is critical. It is important to ensure that the upper sections of each guy are also 18 feet, 3 inches long. Keeping these dimensions accurate will ensure that the loops remain square and resonant. Deviations from a true square configuration will result in loss of gain.

The mast may be roof-mounted or ground-mounted, but roof mounting provides additional height and allows us to use a slightly shorter mast. For roof mounting, a mast height of 39 feet will allow us to secure the lower points of the loops at roof level using insulators. Ground mounting will require a minimum mast height of 45 feet to keep the lower parts of the 20 meter antenna at least 6 feet off the ground. Roof mounting is recommended as the easier installation.

A metal push-up style TV antenna mast will most likely work, but it is costlier and heavier than a wooden structure. There is also the possibility that a metal structure will interfere with the radiation pattern of the

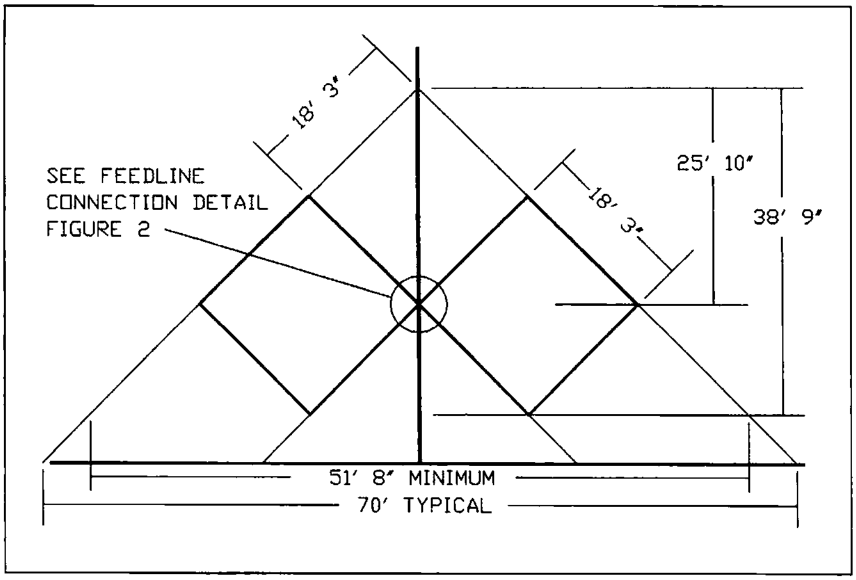


Figure 1. Dual bi-square antenna, elevation view.

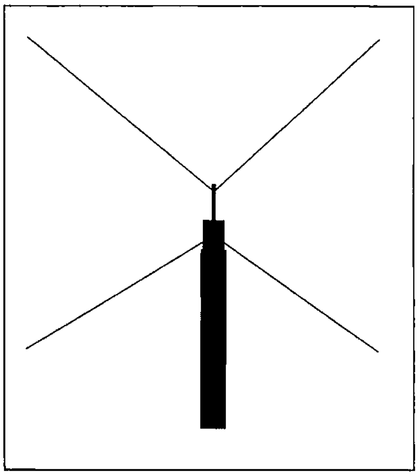


Figure 2. Feedline connection detail.

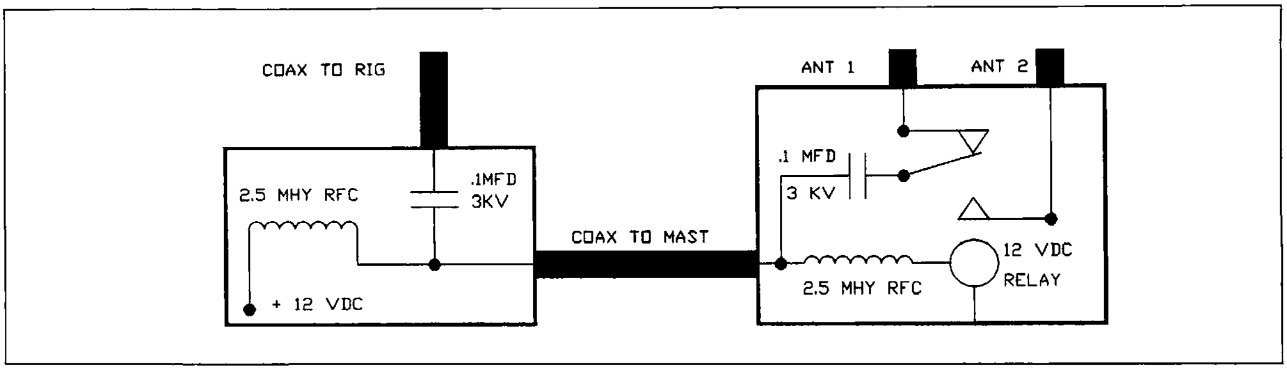


Figure 3. "Wireless" relay switching scheme.

loops. A simpler and less expensive solution is to use 2 x 2 lumber. My installation makes use of a 20-foot length of treated 2 x 6 lumber that has been ripped on a table saw into three 2 x 2 sections. Don't rely on the pressure treating of the lumber as the only protection from the elements. It also needs a couple of coats of varnish or a good grade oil base paint. The actual construction of the mast is detailed in Figure 4.

The primary objective of this project was to obtain maximum results from a minimum of expense and moderate effort. The 3 dB gain 2 meter vertical that was mounted at the top of the mast now allows reliable coverage for local repeater and packet work. The 20 meter bi-loops pick up very little QRN or manmade noise. Compared to other vertically polarized antennas, they are a pleasure to use. SWR over the entire 20 meter band is less than 1.3:1. Directivity switching is instantaneous and the patterns are similar to the clover leaf pattern of phased verticals easing the deep nulls resulting from a single bi-loop.

Although not obvious from Figure 1, the length of the top guy is 54 feet 9 inches (18' 3" times 3). This is a little short for a full-sized 75 meter inverted vee, but we could squeeze in an 80/40 meter trap dipole with ease. It's also a good dimension to use with open wire line and an antenna tuner. Since the mast is not metal the open wire line can simply be attached to the mast with standoff insulators resulting in a neat and proper installation.

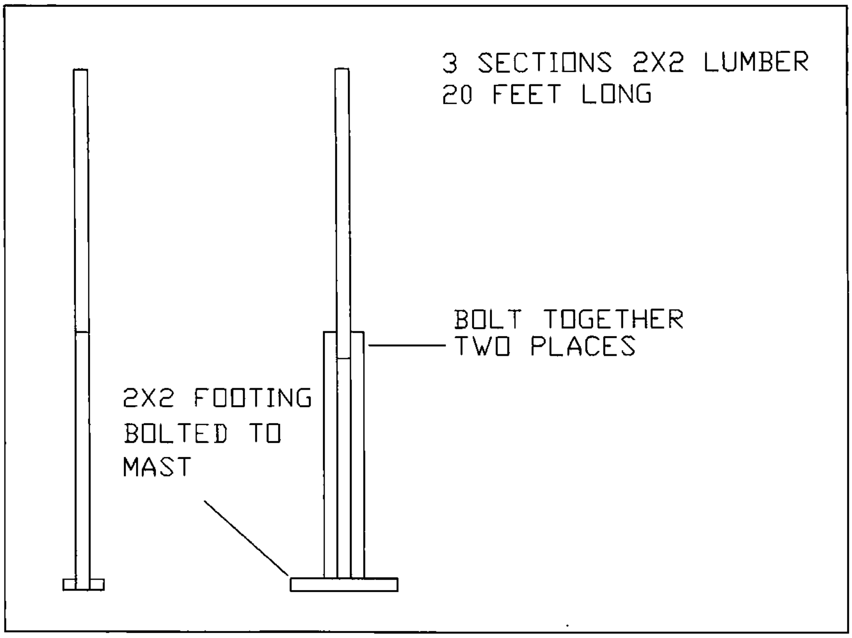


Figure 4. Inexpensive lightweight mast.

Reading Morse Code on your PC

Decipher Morse code right off the air or improve your own fist.

by Robert L. Kurtz W6PRO

[Editor's Note: The following article is an updated and improved version of the author's November 1978 article "World of the Brass Pounders," published in the Wayne Green publication, Kilobaud. *The original idea was based on the 6502 microprocessor, but here the author has adapted his idea to the popular PC family of computers.]*

How good is your CW "fist?" Are your CQs being ignored? It could be your sending. If you have a PC, here is an easy way to check. This simple program for the IBM PC decodes Morse code and prints the output on a PC screen or printer. I wrote this in 1977 for the early KIM computer and recently updated it for the IBM-compatible family. Simply enter this BASIC program and connect your key or keyer to the parallel printer port of your computer.

The program can also be used to decode Morse directly off-the-air. Included in this article is an interface circuit to connect the headphone audio output of your receiver to your computer. With today's fast computers, the program will follow keying speeds well above 40 to 50 words/minute.

Even though the program looks simple, it has some unusual surprises, such as self-adaptive adjustment for changes in code speed. In addition, the influence of changes in dash or dot length is weighted so that they must occur five or six times in succession before the computer decides that there has been a bona fide speed change. As a result, an occasional "bad" character will not mess up your copy; the printout is extremely stable and the copy is relatively foolproof. The program also detects the end of the word and prints out a space, if required.

Loading the Program

Run BASIC on your computer (we used GWBASIC) and type the program exactly as written—with the proper line numbers, etc. Lines 10, 60, 110 and 150 instruct the program to inspect the main parallel port at Hex 379, and the "AND 8" assures that the computer is only looking at pin 15 of the connector, to see whether or not this is grounded. The program assumes when a dot or a dash occurs, a logic 0 appears on pin 15. This is in agreement with a "keydown" shorting pin 15 to pin 18 (ground).

Program Description

Figure 1 is a simplified flow diagram of the program. The initialization routine (lines 1 through 6) sets the lookup table that will permit the printout of the proper character. The program then waits for a keydown to occur (lines 10 and 11). The first part of the operating program (lines 20 through 70) measures the length of time that the key is down and compares this with the stored value for the length of a dash.

If the key is raised in less than one-half of

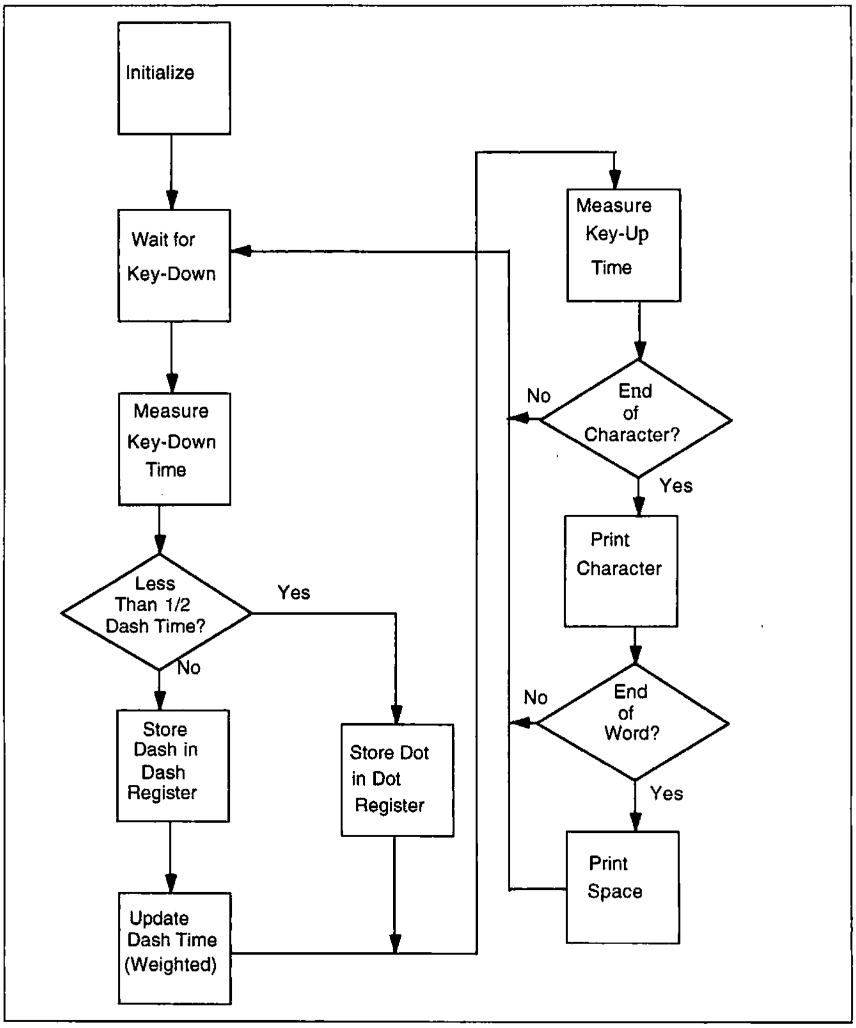


Figure 1. Simplified flow diagram.

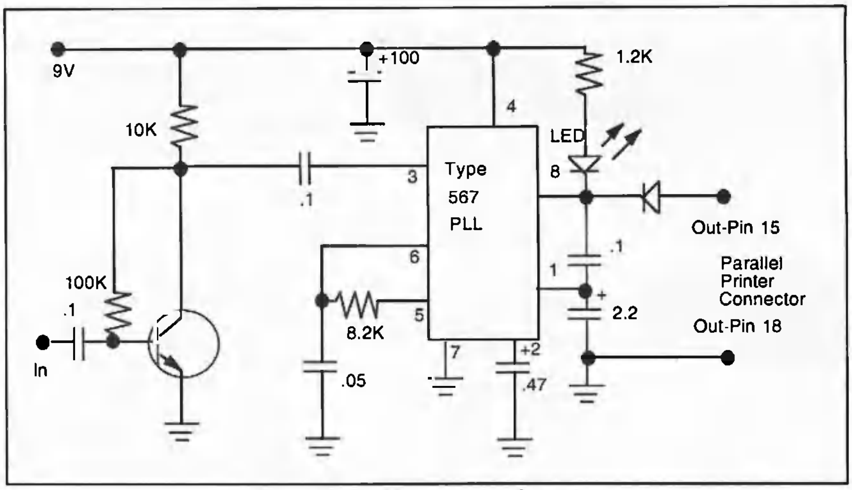


Figure 2. Interface circuit schematic.

the stored dash time, the computer writes a "dot" into the dot register (line 30) and goes to the second part of the program.

If the key remains down longer than one-half of the stored time, a "dash" is stored in the dash register (line 50) and the stored dash time is updated with a one-to-four weighting (line 80). This is accomplished by multiplying the old value of the dash time by four, adding the new value, and then dividing by 5. As a result, the stored value cannot change drastically from character to character, and the copy is not susceptible to errors from erratic sending habits.

The second part of the program measures the length of time that the key is "up." If it's up less than one-half of the dash length, the program assumes that the character is not complete and no printout is provided (lines 100 through 130). If the key is up longer, the program jumps to line 300, the print-character subroutine. If the key is up longer than twice the dash length, the program assumes that a word has been completed and a "space" is printed (lines 170 and 180).

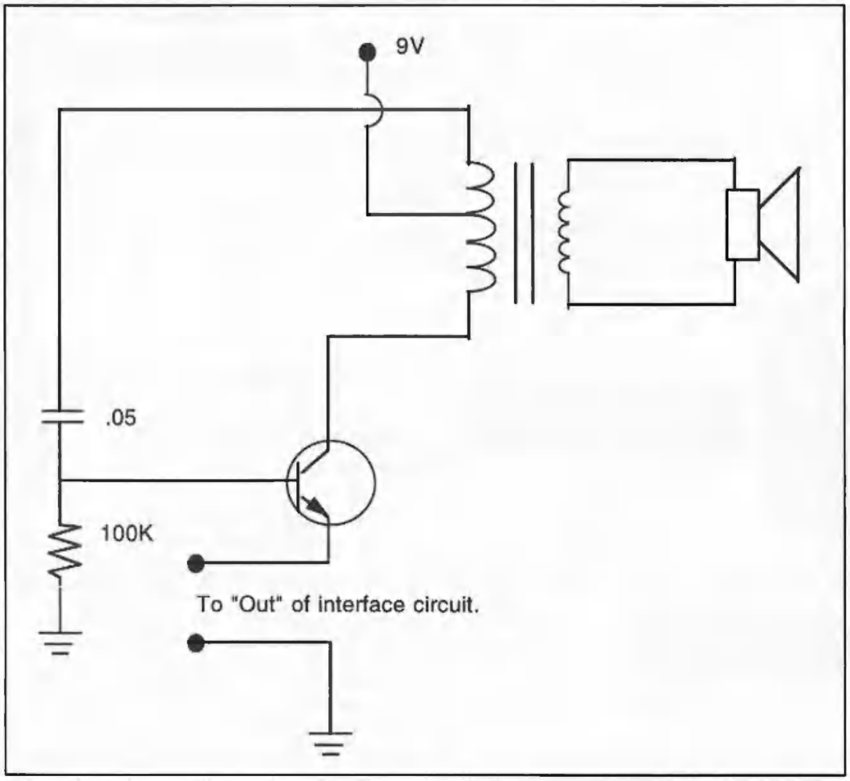


Figure 3. Audio oscillator schematic. This optional circuit may be used to regenerate audio signals from "CW" processed by the interface circuit board. Connect the input of the board to the receiver, and the output to this audio oscillator. The interface board will key the audio oscillator for QRM-free CW.

Lookup Table

The heart of the program is the algorithm that counts the dots and dashes and develops a number used to look up the actual character to be printed. In other words, each combination of dots and dashes in Morse code has a discrete number that commands a given character to be printed. This algorithm has three conditions, as listed in Table 1.

Steps 1 and 2 keep repeating until the character is complete. When the program detects a key-up period longer than one-half of a dash length, it assumes that the character is complete and step 3 is accomplished (lines 300 to 430). The manner in which the lookup number for the letter D is formed is shown in Example 1.

Interface Hardware

As was mentioned previously, to check the program (and your own fist) a key can be connected between pin 15 and pin 18

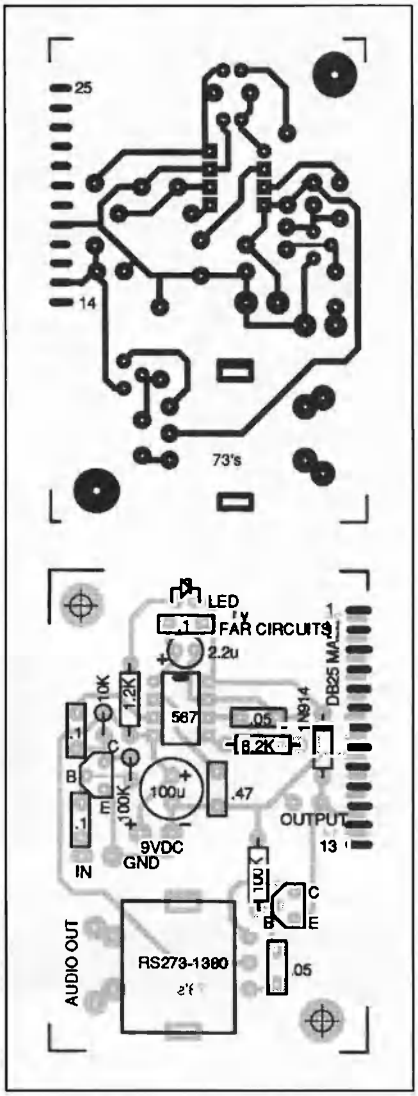


Figure 4. A drilled and etched PC board is available for $4 plus $1.50 S & H from FAR Circuits, 18N640 Field Ct., Dundee, IL 60118.

(ground) of the 25-pin parallel connector on the back of the computer.

Figure 2 shows a typical circuit for connecting your radio receiver speaker or headphone audio output to the computer. The NPN transistor is an R/C coupled audio amplifier connected to a type 567 phase-locked loop (PLL). The free-running frequency of the loop is set by the values of the capacitor and resistor connected to pins 5 and 6 of the 567, and is approximately 2,000 Hz. The capacitors on pins 1 and 2 of the PLL adjust the bandwidth to about 100 Hz, and the LED serves as a tuning indicator—that is, it will start blinking when the signal is in the center of this narrow bandpass.

The output signal goes to a logic 0 (ground) when a dot or dash occurs. The circuit shown has appeared in numerous publications; you may have your own favorite circuit that you would like to use. Be sure that the circuit provides a logic 0 when a CW tone appears.

Incidentally, the circuit has another unique application. Since it is only activated by audio signals over a fairly narrow bandwidth, it can also be used to "key" an audio oscillator set to any frequency desired. When Morse CW comes in amidst a jumble of other signals, the PLL picks out the signal you want and keys the audio oscillator . . . and that oscillator is all you hear.

Adjusting the Program

One of the advantages of writing this in BASIC is the ease with which the computation constants can be changed. For example, you may wish to experiment with different algorithms to detect whether a key-down signal is a dot or a dash . . . to take care of swing-fisters. This can be accomplished easily by changing the factor in line 40 from (.5C) to (.25C) or (.75C). By the same token, the constants in lines 111 and 151 can be changed to provide more leeway for the formation of characters and spaces.

Type this short program into your PC, connect your key or bug to the parallel port—and send a page from *73*. Compare the screen print with the original page and you may get a surprise. It could explain why so many of your contacts complain about QSB or QRM! ■

Type this short program into your PC, connect your key or bug to the parallel port – and send a page from 73. Compare the screen print with the original page and you may get a surprise. It could explain why so many ot your contacts complain about QSB or QRM!

Step 1. If the input signal is a "DASH" -

First - double the values in the dot and dash registers.
Second - add a "1" to the dash register.
(see line 50)

Step 2. If the input signal is a "DOT" -

First - double the values in the dot and dash registers.
Second - add a "1" to the dot register.
(see line 30)

Step 3. If the character is complete -

First - double the value in the dash register.
Second - add the dash and dot registers to obtain the look-up number.
(see lines 300-350)

Table 1.

Reading Morse Code on Your PC

Continued from page 26

```
1 REM MORSE CODE READER - WRITTEN BY R. KURTZ - W6PRO
2 RESTORE
3 CLS: REM CAN DELETE - PUTS CURSOR AT TOP OF SCREEN
4 REM TO SEND DIRECT TO PRINTER - USE  LPRINT  IN LINES 180 AND 340
5 DIM AS(100)
6 FOR H=1 TO 100:READ AS(N):NEXT N
10 A=INP(&H379) AND 8
11 IF A>7 THEN 10
15 B=0
20 A=INP(&H379) AND 8:B=B+10
25 IF A<8 THEN 40
30 C=((5*C)+(2*B))/6:DT=2*DT:DA=2*DA:DT=DT+1:COTO 100
40 IF B<(.5*C) THEN 20
50 DT=2*DT:DA=2*DA:DA=DA+1
60 A=INP(&H379) AND 8:B=B+10
70 IF A<8 THEN 60
80 C=((4*C)+B)/5
100 B=0
110 A=INP(&H379) AND 8
111 B=B+10
120 IF A<8 THEN 15
130 IF B<(.5*C) THEN 110
140 OOSUB 300
150 A=INP(&H379) AND 8
151 B=B+10
160 IF A<8 THEN 15
170 IF B<(2*C) THEN 150
180 PRINT " ";
190 GOTO 10
300 DA=DA*2
310 D=DA+DT
330 IF D>100 THEN D=100
340 PRINT AS(D):
350 DA=0:DT=0
360 RETURN
400 DATA E,T,I,A,N,M,S,U,R,W,D,K,G,O,H,V,F,-,L,-,P,J,B,X,C
410 DATA Y,Z,Q,-,-,5,4,-,3,-,-,-,2,-,-,-,-,-,-,-,1,6,-,/,-
420 DATA -,-,-,-,7,-,-,-,8,-,9,0,-,-,-,-,-,-,-,-,-,-,-,-,?
430 DATA -,-,-,-,-,-,-,-,,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-,-
```


EXAMPLE: D = — • •

Initial conditions: Dot Register = 0, Dash Register = 0

First interval: Input a dash

2 times dash register = 2 X 0 = 0
2 times dot register = 2 X 0 = 0
Add 1 to dash register = 1 + 0 = 1

Summary - dash register = 1, dot register = 0

Second Interval: Input a Dot

2 times dash register = 2 X 1 = 2
2 times dot register = 2 X 0 = 0
Add 1 to dot register = 1 + 0 = 1

Summary - dash register = 2, dot register = 1

Third interval: Input the second Dot

2 times dash register = 2 X 2 = 4
2 times dot register = 2 X 1 = 2
Add 1 to dot register = 2 + 1 = 3

Summary - dash register = 4, dot register = 3

End of Character - determine look-up number for "D"

2 times dash register = 2 X 4 = 8
Add Dot and Dash registers = 8 + 3 = 11

Answer: "D" is the eleventh character in the Data file.

Example 1.

73 Review

Number 8 on your Feedback card

by Pete Putman KT2B

Midland International Corporation
1690 North Topping
Kansas City MO 64120
Telephone: (800) 669-4567
Price Class: 18-405 2 meter base station antenna—$99.95 (MSRP)
18-410 dual-band 2M/440 base station antenna—$169.95 (MSRP)

Midland Corporation Models 18-405 and 18-410 Base Station Antennas

Good VHF/UHF performance at a moderate price.

In the June 1994 issue of *73* I took a look at Midland International Corporation's 18-300 series of high-quality mobile antennas for 144 and 440 MHz. At the time, I remember thinking, "Wouldn't it be great if Midland also had a line of base station antennas that worked as well as these and were moderately priced?"

Well, the good news is that Midland does have 'em, and I was able to procure a couple for this review. Both are collinear designs, employing more than one active element driven in series. Both are rugged and easy to put together, and their performance is definitely on a par with the mobile antennas.

18-405 Monoband Base

This antenna can be configured by the user for any band segment between 136 to 225 MHz, although I didn't evaluate its performance outside the 2 meter band. The 18-405 is a fairly lightweight but rugged design, using aluminum element material and stainless steel hardware throughout, and weighing only a couple of pounds. (See Photo A.) The active antenna array uses a pair of 5/8-wave elements with a matching coil in between; an adjustment chart provided by Midland gives you the lengths of each of the four sections, although I tried three different adjustments to get the best VSWR across the 2 meter band.

Stainless steel hose clamps are used to secure the concentric element sections, and after about a year of use they haven't budged an inch. My final and most satisfactory results came with an overall length of 124" (10' 4"), so if you are planning to use an 18-405 make sure you have the vertical clearance! The ground radials are pre-cut at the factory and install into tapped holes on the base of the antenna, projecting out at about 30-degree angles (which is close to optimum for a 50 ohm feed, by the way).

The antenna connectors on the 18-405 and 18-410 look sort of like Type N receptacles at a hurried glance, but they are genuine UHF connectors! A decoupling sleeve which doubles as the antenna mast mount slides over your coaxial cable and is fastened to the antenna's base with machine screws. This permits the installation of a pair of "U" brackets and bolts, offsetting the mast mount on up to 2" mast material. (See Photo B.) This system is great for protecting the coax from inclement weather and will no doubt attract small insects looking for a dry home. Because the two mounting brackets can twist away from each other when tightening, you'll need a level when installing the antenna to ensure it is truly vertical.

Performance

The 18-405 works very well in base station operation, but breaks down into a small enough package that it is ideal for hamfest talk-ins, special events, and even Field Day. As I mentioned earlier, it took a few tries to get the SWR across the band to my liking, but eventually I saw a maximum of about 1.8:1 at 144 MHz with a Bird Model 43, dipping down quickly to under 1.09:1 at 146 MHz and rising back to 1.7:1 at 148 MHz, indicating that the antenna is somewhat narrowband in performance, which is usually a direct consequence of any design to produce higher gain.

In on-air tests, the 18-405 worked about as well as my older F9FT four-element yagi, which has a fairly broad pattern to begin with (-3 dB at 75 degrees). But there's no doubt that it helped me access some fairly distant repeaters with a mere 5 watts from my IC-02AT. At the time, the 18-405 was temporarily fastened to my deck with a couple of bunji cords and sat on a 10-foot mast! Midland claims a gain figure of 7.5 dBi for the antenna, no doubt due to its fairly low radiation angle. While not able to substantiate that

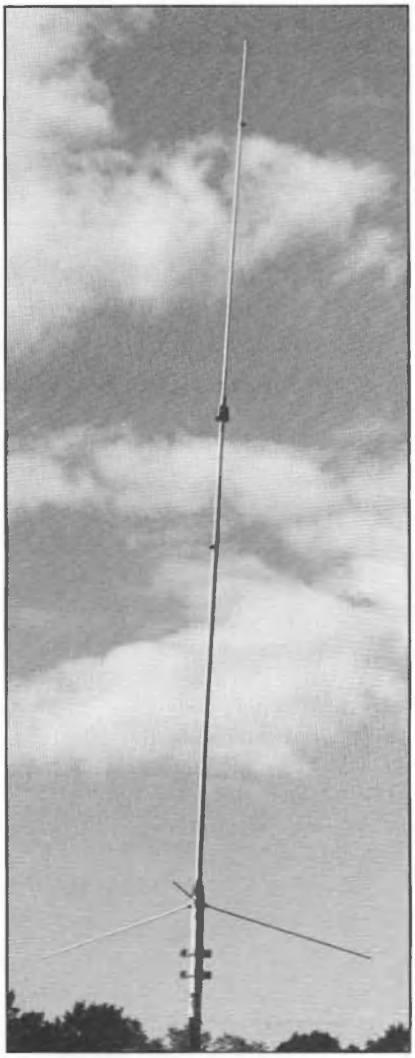


Photo A. The Midland 18-405.

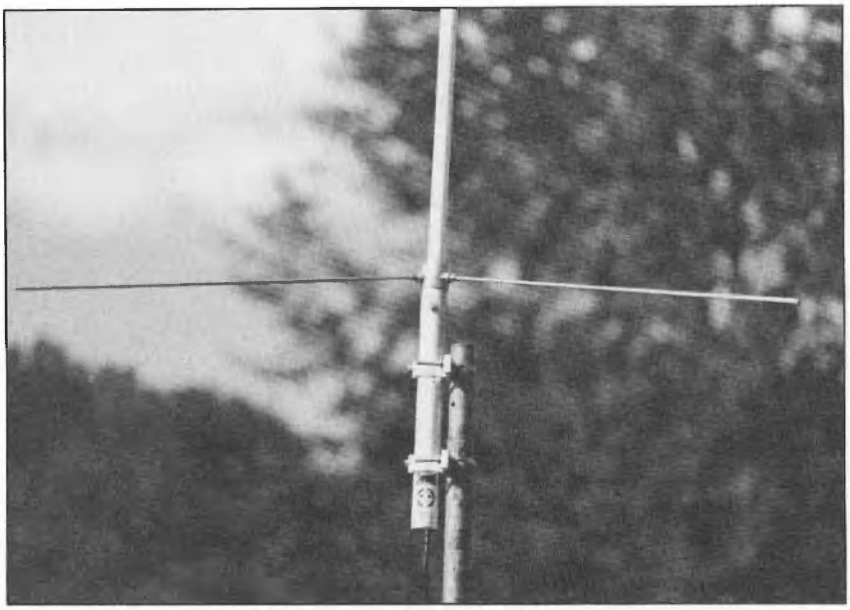


Photo B. The antenna mounting arrangement for the 18-405 and 18-410.

figure, I will say that the 18-405 is a big improvement over the typical 5/8-wave ground plane. By the way, the 18-405 is rated at 200 watts maximum.

18-410 Dual-Band Base

The 18-410 is about as different from the 18-405 as possible in physical appearance and construction. It uses a pair of 5/8-wave collinear elements on 144 MHz and four 5/8-wave elements on 440 MHz, encasing them in a Fiberglas radome sheath measuring 100" (8'4") in length. (See Photo C.) Like its sister antenna, the 18-410 is very light when tipping the scales, but no compromises have been made with the antenna hardware—it's all stainless steel. Unlike the 18-405, the 18-410 comes prealigned from the factory, eliminating the need for "tweaking" the element lengths. You just slide the top radiating section and coil assembly into the bottom, tighten a small screw (don't drop it—I did, right through my element-eating deck) and connect the two sections of the radome with a ferrule and compression nut.

The ground plane is provided by the same pre-cut stainless steel radials that thread into the antenna base with a coaxial sleeve nut. Again, the decoupling sleeve and mast support attaches with a single screw to the base and uses a pair of "U" clamps to attach to up to a 2" mast. As before, a level is recommended during installation to be sure the antenna is truly vertical. Wind loading will be somewhat reduced with the 18-410 as it measures over a foot and a half shorter than the 18-405, so don't hesitate to use it as the "star" on your antenna "tree" of beams if you've got a strong rotor.

Since the antenna was "factory aligned," I expected to see fairly good SWR performance. Midland claims under 1.5:1 from 144-148 MHz and 440-450 MHz, so I swept the antenna over this range using a 5 watt RF source and a Bird 43. On 2 meters, I saw about 1.9:1 at 144 MHz, using the suggested settings, dropping to 1.5:1 at 145 MHz and 1.4:1 at 146 MHz. At 148 MHz, I measured 1.8:1, so the 18-410 didn't quite make its factory spec. Should you be concerned about seeing 9% reflected power? Well, I generally disregard numbers under 2:1 as current transceivers and handi-talkies using hybrid power modules are quite happy at this level before power starts to get cut back.

"In a nutshell, the 18-410 was the hit of Field Day '94 for the Warminster ARC."

On 440 MHz, the 18-410 exhibited a 1.4:1 VSWR, climbing steadily to 1.8:1 at 450 MHz. Again, the antenna didn't quite match Midland's specs, but the results are certainly nothing to be concerned about. Just for the fun of it, I continued down the 70cm band and swept the antenna at 430 MHz, where I observed 1.4:1 again. The actual "dip," or point of maximum resonance, took place between 434 and 436 MHz where the VSWR measured 1.06:1, indicating that Midland might want to fiddle a bit more with the match on the 440 MHz element. The claimed gain figure for the 2 meter element is 6 dB better than a 1/4 wave, while the 70cm figure is 8 dB better.

Performance

In a nutshell, the 18-410 was the hit of Field Day '94 for the Warminster ARC. Their VHF station needed an omnidirectional antenna for FM work, so being ever the helpful amateur, I offered up the 18-410. It was set up on the top of 30' of Rohn tower sections atop our magnificent site at the Shrine of Cheztohowa near Doylestown, PA. From this 600'+ perch, we were able to work stations up and down the Delaware River valley, well into New Jersey, Delaware itself, and even New York City—a range of over 50 air miles. Of course, having a 100 watt "brick" helped out, but the antenna's performance was impressive nonetheless.

While the 18-410 does have a lower radiation angle than a quarter-wave antenna, its pattern resembles that from a standard 5/8-wave base station. However, the bonus here is that for a comparable antenna size, you get dual-band coverage. For users of dual-band transceivers and HTs, that's good news as the price is reasonable. What's more, the 18-410 also breaks down very quickly for special event and emergency use, making it just as versatile as its sister product for 2 meters. Like the 18-405, its power rating is 200 watts. 73

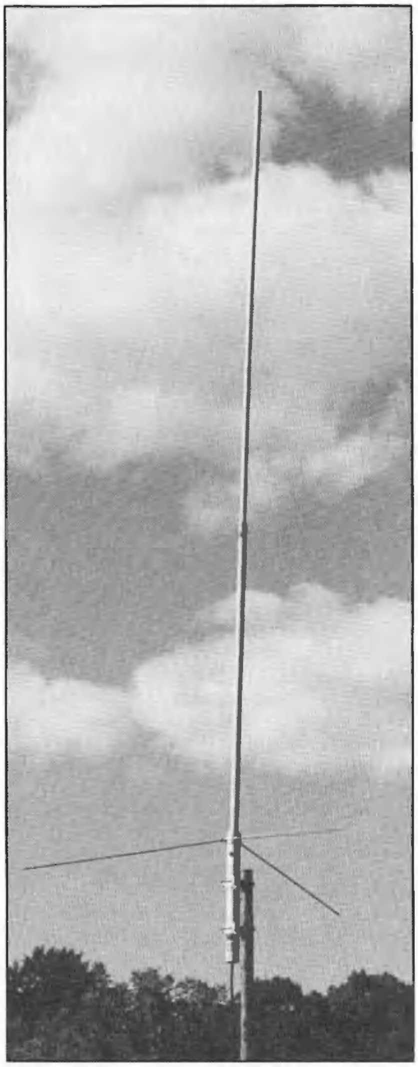


Photo C. The Midland 18-410.

Number 9 on your Feedback card

73 Review

Down East Microwave DEM 144-28K and DEM 222-28K Linear Transverters

by Peter Putman KT2B

Down East Microwave
954, Route 519
Frenchtown NJ 08825
Telephone: (908) 996-3584
FAX (908) 996-3702
Price Class: DEM 144-28K and DEM 222-28K—$295, including predrilled case, board, heat sink, and all components and mounting hardware. Fully assembled—$395.

A big step forward in transverter design.

It seems that more and more equipment for VHF and UHF weak-signal operation is being priced out of the reach of casual operators and newcomers to the world above 50 MHz. Forget what the articles and experts say about "radio equipment actually costing less in today's dollars": $1,500 to $3,000 for a multiband VHF/UHF transceiver is still a lot of money that might be better spent elsewhere. And there's no guarantee that money will buy you top-notch receiver sensitivity, dynamic range and truly linear operation.

The answer for many VHF/UHF enthusiasts has been to use an existing HF radio in conjunction with something called a transverter—shorthand for transmit/receive converter. Transverters convert signals to and from the desired VHF, UHF and even microwave bands to a frequency already present on an existing HF radio. For operation on 50, 144, 222 and 432 MHz, that frequency will typically be 28 MHz, although some designs have down converted to 15 meters and even 20 meters.

What's the Advantage?

Why use a transverter in the first place? For one thing, you retain all of the "bells and whistles" of a radio you're intimately familiar with: that deluxe, 160-10 meter, general coverage radio with IF shift, passband tuning, filter options, memories, multimode operation and (hopefully) a transverter connection on the rear panel. This means your cash outlay becomes more reasonable as you can get on each new VHF band for as little as $300, with a bit of sweat equity, some tools and a soldering iron.

Another advantage of transverters is that their inherent simplicity means that they don't have to take up much room nor use much power. There's plenty of opportunity to experiment with preamplifiers, power amplifiers and antennas as a result of the $$$ you've saved. And if the transverter was built from a kit, you can do your own troubleshooting when problems arise.

Some Brief History

The concept of a transverter is certainly not new. Old ARRL *Handbooks* abound with designs of tube-type linear receive and transmit converters designed to work with 20 meter monoband radios. With a good crystal-controlled local oscillator, frequency stability was assured. And owners of the then-new SSB rigs could experiment with this mode at a minimal cost on 6 meters, 2 meters and above.

To fully realize the reduction in size, however, it took the introduction of solid-state circuits using Field Effect Transistors (FETs) and reliable RF power transistors to perform the up/downconverting, mixing, and amplification functions. Further developments reduced the noise figure of FETs while increasing the gain of both low- and high-level RF amplifier stages. It was during the 1970s that we began to see self-contained "black box" models come on the market, taking as little as 1 mW of drive and producing 10 watts of true linear power.

Perhaps the best known incarnation of this design came from Microwave Modules in England. Thousands of these boxes have been sold since the mid-'70s and continue to sprout up at hamfests across the country. Their simple design and fairly reliable performance made them a good buy at their original prices (between $200 and $300), and they can still be found selling for as little as $100. The original design used a pair of MOSFETS (3N204/40822) as active mixers, combining a low-level 28 MHz signal with an on-board 116 MHz local oscillator. The sum frequency of 144 MHz was then amplified two or three times to 10 watts output.

On receive, a 3N204 or 40673 served as the front end, feeding another 3N204 single-ended mixer whereby the difference frequency (144 - 116 = 28 MHz) was then amplified and fed back to the HF radio. MMTs (as we long-time users liked to call them) were fairly linear devices, but as time wore on their limitations became more evident: the reduced dynamic range of the active mixers, the noise figure of the front end stages (especially at 432 MHz) and the limited power output of 10 watts.

With the demise of Microwave Modules (and its parent, Castle Microwave) in the late 1980s, several industrious hams began tinkering with their own designs, prompted by the availability of low-cost, low-noise GaAsFETS and stable, high-gain MMICs. Down East Microwave, a leading vendor of linear microwave transverters, responded with its DEM 432-28K in 1992 (reviewed in the January 1993 issue of *73*). Here was a high-performance linear transverter, using Avantek GaAs devices in the front end and broadband MMIC mixer/amplifier stages.

Higher power output was realized with a no-tune hybrid power module, resulting in a true no-tune design that was a significant step up from the old MMT 432/28S.

In recent years, Down East has expanded its line by adding a no-tune 50 MHz linear transverter using the same techniques. It was only a matter of time before the 144 MHz and 222 MHz "holes" were plugged with comparable designs, which were shown for the first time at Dayton 1994. (See Photo A.) What makes the DEM 144-28K and 222-28K designs different (and better) than their English predecessors is the use of a passive mix-

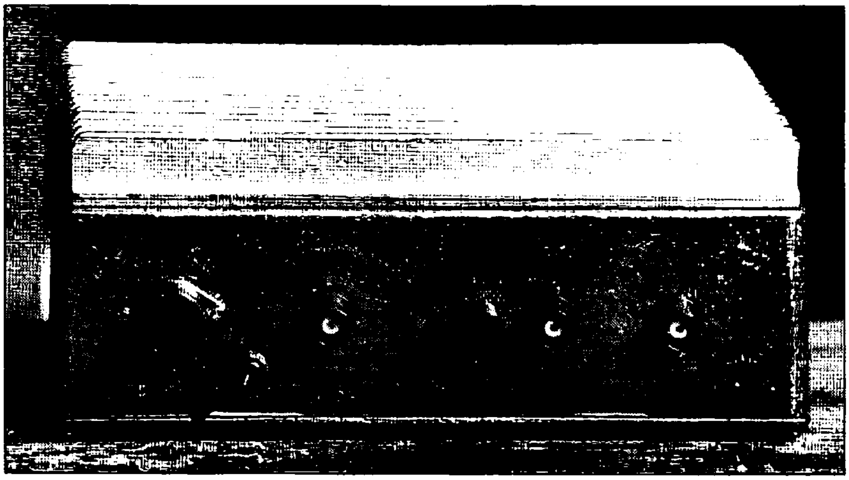


Photo A. A no-tune linear transverter from Down East.

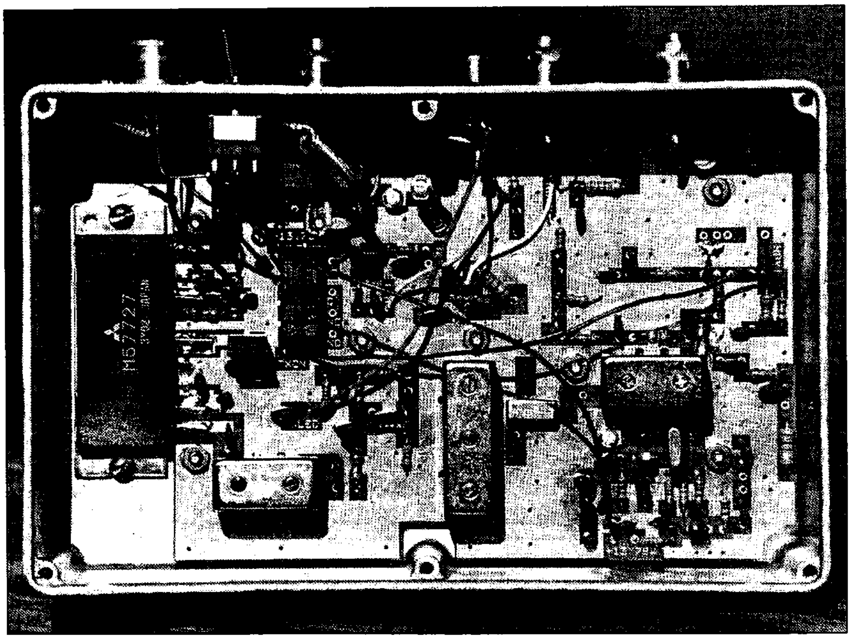


Photo B. The DEM 144-28K transverter.

er design for both transmit and receive conversion. Although there is loss in a passive mixer, the increase in dynamic range more than makes up for it.

On receive, a GaAsFET ahead of the mixer provides plenty of gain at very low noise figures, while MMICs after the mixer help increase conversion gain at 28 MHz to a satisfactory level. 28 MHz transmit signals are processed in the same way, combining with the LO signals in the same mixer and then boosted by a couple of low-level RF stages before the hybrid power module. The only adjustment in either case is the local oscillator trimmer capacitor—everything else just works without tweaking.

DEM 144-28K

This transverter (and its companion design for 222 MHz) are not reworked versions of the DEM 432-28, as was originally rumored. Instead, they are totally new designs from the desk of Steve Kostro N2CEI who distributes many of Down East's products. The goal here was lots of dynamic range in both transmit and receive modes, as well as a stable circuit with very little lumped components (Photo B).

Although both boxes are sold as kits, the amount of assembly work required shouldn't scare anyone off. For one thing, the PC boards are professionally laid out double-sided, G10 epoxy material with plated-through holes.

They've been pre-drilled for all components, filters and mounting screws and notched to fit inside the supplied Hammond die-cast chassis. This chassis has also been drilled for the mounting screws, which thread into pre-tapped wholes in a piece of ribbed heatsink material that attached to the bottom of the box. The mounting holes and taps are also pre-drilled for the Mitsubishi power modules which means all the builder needs to drill out and mount are three BNC connectors, a switch, two LEDs and two RCA jacks. *[Editors Note: All holes are now pre-drilled at the factory.]*

How They Work

In the 144-28K, low level signals from the 10 meter IF radio are fed through a resistive pad net-

work and sent to a Mini Circuits TUF-1H passive mixer stage. The transverter is designed to accept signals from 1 mW to 100 mW, but there is a provision on the board for an optional MAR-6 MMIC stage to boost the low transverter drive from certain radios, such as Icom's 740/845/751/735 and later series. The local oscillator uses a pair of bipolar transistors to produce about +15 to +17 dBm of signal, which is combined in the TUF-1H mixer with the 28 MHz IF. (This is considered a high-level mixing scheme).

From here, the combined 144 MHz signal is then amplified by a MAR-6 MMIC which drives an MRF 559, producing about 50 to 70 milliwatts. This is in turn fed to a M57727 power module which produces between 20 and 30 watts output, depending on drive level. Filtering of spurious responses occurs in three places. First, a Toko 1153A 2-pole filter is used between the LO and mixer. A Toko 1119A 3-pole filter is employed after the mixer, and another two-pole 1159A is placed between the MRF 559 and power module. The result? Down East claims spurious down better than -65 dB.

On receive, the incoming signal is fed to a Hewlett-Packard ATF13484 GaAsFET which offers plenty of gain with a very low noise figure but high dynamic range. This is then amplified by a MAV-11 MMIC and fed back through the same TUF-1H mixer. The resultant 28 MHz signal is fed directly to the 10 meter radio, although another optional gain stage can be added to increase the conversion gain by roughly 10 dB. If you are using an older HF transceiver with reduced front-end performance, you'll probably want to add this extra stage.

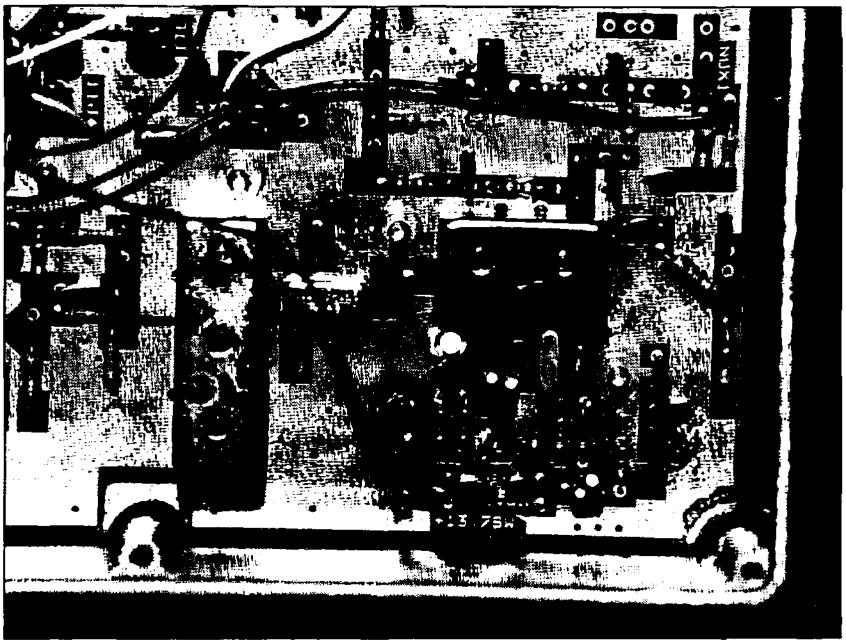


Photo C. Local oscillator and filter stages on the 222-28K.

The 222-28K doesn't differ much from the 144-28K, with a few exceptions. The LO runs at 97 MHz instead of 116, and another MMIC stage is used as a frequency doubler stage to get to 194 MHz before the mixer. (See Photo C.) The same filter arrangement is used, but Toko 1164A, 1145A and 1166A two- and three-pole models are substituted. The power module is a Mitsubishi M67712, which in my finished unit made about 18 to 20 watts output. The HP ATF13484 GaAsFET

is also used ahead of a MAV-11 MMIC stage, and the same optional MMIC stages are available for low-level 28 MHz drive and additional conversion gain.

Construction

I spent part of a vacation week assembling the 144 and 222 MHz models. For an experienced builder, one weekend of casual "catch time as you can" is more than enough to build either box and align them, but if you're determined, you can crank both boxes out in one day. Start by laying out sheets of white paper or posterboard to keep track of all the small parts, such as resistors, disc capacitors, semiconductors and hardware. All chip resistors and capacitors are taped to a white index card and clearly identified.

For tools, you won't need more than a soldering iron, diagonal cutters, needle-nose pliers and two drill bits: 3/32" and 3/16". Down East provides more than enough enameled wire for the six coils you'll need to wind for each kit, and the balance of the coils are sealed inductors. The instructions provided are a bit on the skimpy side, although a detailed board layout and parts placement diagram are included along with a schematic.

The Toko filters are prealigned and require no adjustment once they're installed, so resist the temptation to do any "tweaking" unless you have access to a network or spectrum analyzer. My suggestion is to populate the circuit boards with all resistors, coils and disc capacitors first, then install the filters and small chip components. The MMICs and GaAsFET can be installed last.

Another suggestion would be to install everything including the two relays, but leave the power module out to allow bench testing before final assembly. The reason for this was a problem I had with the supplied OMRON B5Y-1 50 ohm relay on the 222-28K: It didn't work at all. A call to Down East brought a quick replacement, whereupon I was able to verify power output from the MRF559 stage.

Depending on your 28 MHz source, you'll probably want to install the optional 28 MHz RX booster stage. My IF radio is the time-tested Kenwood TS-430S, which was never known for having a terribly hot front end so it benefited from the extra boost. I didn't need the optional 28 MHz TX booster stage as the TS430S has over 10 mW of drive available. On the 222 MHz unit, I was not satisfied with the overall system conversion gain, so I substituted an Avantek ATF10135 in the front end with noticeable improvement. (Apparently there have been changes made to the Toko filter tunings since I bought my kits and later versions have more gain all through the system.)

Alignment is fairly simple, but you should use a 50 ohm dummy load and wattmeter to verify power module performance. Power output should be evident with as little as -12 dBm of drive, assuming you haven't installed the optional TX booster. If you have access to a calibrated signal generator or on-air beacon, you can tweak the two trimmer capacitors on the RX input for maximum gain and be fairly close to the optimum noise figure, under 0.5 dB.

Performance

Both boxes displayed excellent numbers on the test bench, which consisted of a Hewlett-Packard 608F signal generator and a Boonton 92 RF millivoltmeter. The HP608F did double-duty as a calibrated RF source at 144 and 222 MHz for receive tests, and as the IF exciter at 28 MHz. An ICOM IC-751A served as the receiver for weak signal tests.

The 144-28K exhibited very linear performance over a wide range of transmit and receive signals. At -30 dBm of 144 MHz input, I determined the system conversion gain to be about 28 dB. (I usually like to see an "S9" signal on my HF radio with 1 uV of signal at the VHF frequency.) I was able to increase the 2 meter input signal to the transverter to -25 dBm (11 millivolts) before I saw 1 dB of compression, which is an excellent figure. The 144-28K would appear to have what it takes to stand up in high RF fields, such as during a contest. Less than 0.15 µV was needed to produce 10 dB S/N.

On transmit, I saw 1 watt of output at -12 dBm. Cranking the HP608F up to 0 dBm (1 milliwatt) produced 10 watts of output across 50 ohms, as measured with a Bird 43 and 25C slug. An increase to +3 dBm (2 milliwatts) saw a corresponding increase to 20 watts output. The power output begins to level off after this point as either the mixer or following stages saturate. My maximum output was 25 watts at +7 dBm, the upper limit of the 608F. LO leakthrough at 116 MHz was measured at -21 dBm, over 60 dB below the carrier.

The 222-28K also exhibited very linear performance, if not slightly better than the 144-28K on receive. This was probably due to the substitution of the GaAsFET from the HP model to the Avantek ATF10135. System conversion gain with the optional RX boost was measured at 29 dB, and I was able to crank a signal of 19 dBm (25 mV) into the transverter before it went into compression, another tough performer for contest work. Again, less than 0.15 µV produced 10 dB S/N.

On transmit, the 222-28K is a bit more sensitive than its 2 meter brother, producing 1 watt of output at -18 dBm drive. Increasing this to 0 dBm resulted in 12 watts, however, as the system went into saturation. Increasing drive further to +3 dBm resulted in 17 watts output. I understand that the changes made to the Toko filter tuning by N2CEI is now resulting in over 25 watts output from the M67712 power module. LO leakthrough at 194 MHz was measured at -21 dBm.

On the Air

I was able to put a few hours on the air during the ARRL September VHF QSO Party, using the 144-28K with a 19-element yagi and 200 watts and the 222-28K with a 13-element yagi and 120 watts. Some enhancement was observed during the contest, but for the most part I made contacts under normal conditions, working into Canada (FN25), the Virginia shore (FM27), West Virginia (FMØ8) and western Pennsylvania (FNØØ).

In each case, I tried the transverters with my amplifier's built-in GaAsFET preamps, and opted to leave them off as both front ends are quite sensitive. The filter options on the TS430S took care nicely of some strong adjacent signals that gave my older MMT boxes fits! It took a lot of signal from a nearby 1 KW station with my beam right on him before I noticed significant crunching and IMD products.

Conclusions

Both the DEM 144-28K and 222-28K represent a big step forward in transverter design for both veteran and new VHF/UHF weak signal operators. With the wide range of TX and RX options, any model HF transceiver on the market should work fine with either box. Their output is tailored to the current line of brick amplifiers from RF Concepts, TE Systems and Mirage, but you probably won't need the internal preamp as the ATF GaAsFETs are more than up to the job.

Two minor complaints: First, the instructions could be a bit more detailed. I've built plenty of kits over the years but can make mistakes just as well as anyone else! Also, the parts placement diagram would benefit from a tinted overlay to show circuit traces in relation to solder holes—there's a couple of places where it would be easy to insert a component into the wrong holes, and plated-through holes are difficult to desolder. However, Bill Olsen of Down East Microwave has always provided me with solid technical and parts support, especially in the case of the defective relay.

Number 10 on your Feedback card

73 Review

by *Steve Katz WB2WIK/6*

Sentech, Inc.
P.O. Box 2136
Riverview, FL 33569
Telephone: (813) 677-4410
Price Class: $99.95 (U.S.),
plus $6 UPS shipping

The Sentech Model Q144-8 2 Meter Quagi Antenna

Take another look at this VHF workhorse.

The Quagi is a beam-type antenna combining the advantages of a cubical quad and a yagi. Quagis were unheard of (although probably experimented with) prior to the publication of the first design and construction articles in *QST* (1977) by Dr. Wayne Overbeck N6NB, but have become very popular among weak-signal VHF-UHF enthusiasts. The term "Quagi" has become generic by virtue of their designs being published in the *ARRL Antenna Book* and elsewhere every year since the original articles appeared.

While multi-element, long-boom quads work fine at VHF, their additional windloading and complexity of construction makes their use cumbersome. Yagi-Uda beam antennas are simpler to build and install, consume less vertical space and offer reduced windloading, explaining their popularity with amateurs and commercial users since their invention. Overbeck, an avid VHF-UHF contester and early-years moonbouncer, did a great deal of groundwork back in the mid-1970s to determine that the primary advantage of the quad over the yagi could be achieved by the use of full-wavelength loop driven and reflector elements, and that substituting linear directors for the conventional loop director elements used in longer quad antennas sacrificed almost nothing in gain and other desirable characteristics. Thus, the "Quagi" was born, using quad loop driven and reflector elements on the same boom as straight linear director elements. The Quagi, by virtue of the full-wavelength loop driven element, begins life with some degree of gain over a conventional half-wave dipole and therefore has an advantage right from the start, even before adding parasitic elements to form its directional pattern and increase gain.

The loop driven element has gain over a half-wave dipole because it has twice the aperture, or cross-sectional area. In addition, the full-wave loop does not have its high-impedance (and thus high-voltage) points at the element tips like a half-wave dipole does, since there are no element tips at all. This allows use of the loop driven element in more severe environments, such as rain and snow, because the element is less prone to detuning from precipitation buildup at the element ends. Overbeck determined empirically that the advantage of the loop driven element could be enhanced by the use of a loop reflector, but conventional loop directors could be replaced by linear director elements with little degradation in performance; he also determined that for a given boom length, nearly any Quagi offers more forward gain than a conventional yagi possibly can. He published his design data only after personally using Quagis in successful contest, portable, moonbounce and other weak-signal operations, and the rest is history. No experienced weak-signal VHFer is unfamiliar with Quagis, and many are using home-brewed ones.

Photo A. The inventor of the Quagi, Wayne Overbeck N6NB, holding the assembled driven element and partly-assembled reflector element from the new Sentech Q144-8 Quagi. Wayne is beaming like a proud papa.

N6NB's original Quagi design calls for using a non-conductive boom (typically bamboo, wood, Fiberglas, or even Plexiglas for short-boom UHF arrays) and loop elements made of #12 vinyl-covered copper household electrical wire. While thousands of these have likely been built, most won't survive severe weather because of the lightweight materials used. (Wayne is a personal friend of mine, and I've seen him build a complete 2 meter, eight-element Quagi in less than 30 minutes, from scratch, at a total cost of maybe $10. The inexpensive, lightweight materials do have some advantages for those building lots of temporary antennas.) But now weak-signal enthusiasts have the option to purchase a much heavier-duty Quagi made of precut, machined materials, to yield a high-performance antenna at a reasonable price: Enter Sentech, Inc., of Riverview, Florida.

The New Option

Sentech, owned and operated by Lowell Malo WBØMGS, has been offering competitively-priced, high-quality Quagi antenna products for more than a year. I worked Lowell on 6 meters back in June during a coast-to-coast E-skip opening, and then called him on the telephone to discuss the Quagi product line. Then I bought one.

I showed the new antenna's parts to Wayne N6NB before assembly. He made some quick measurements on the quad loops and the director element lengths and concluded that Sentech had probably done their homework and adjusted his original design to accommodate the different materials used. Instead of insulated #12 copper wire (which can deform if a large bird nests on it!) for the loop elements, Sentech has used bare 3/16"-diameter solid aluminum. Sentech's materials are much stronger, but require adjustment of the loop dimensions because of the reduced wire inductance and increased velocity of propagation. N6NB's original design, optimized for 144.5 MHz, used an 86-5/8" loop for the reflector, and an 82" loop for the driven element; sure enough, Sentech has

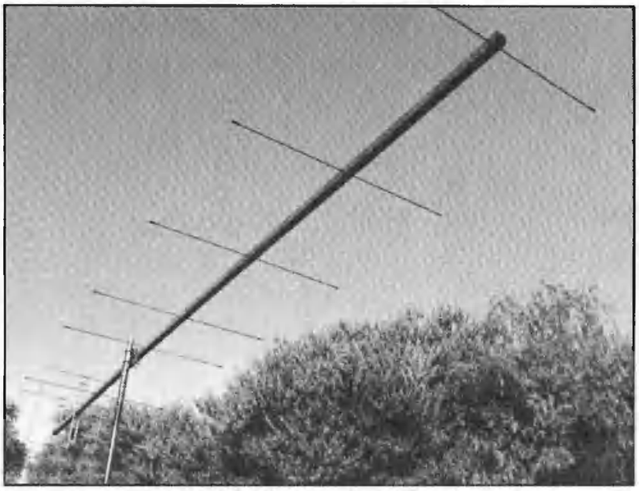


Photo B. The completed Quagi.

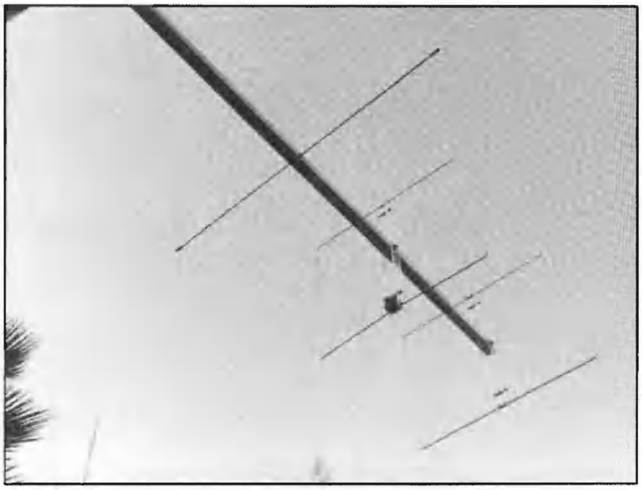


Photo C. The "business end" of the assembled Quagi, showing the reflector and driven element quad loops and their mounting arrangements. You can also see the first linear director element.

changed this, and uses an 88" loop (not quite square, but this isn't important) for the reflector and an 84" loop (also not quite square, with the same form factor as the reflector) for the driven element.

The original Quagi used an insulated boom and brazing rods for the director elements; Sentech uses a square aluminum boom (assembled from three sections) with 3/16" aluminum directors insulated from the boom by Delrin stepped washers, held in place by spring steel retainer clips. N6NB also used wooden "spreaders" to support the quad element loops and attach them to the boom, and the 2 meter Quagi used two such spreader "arms," one vertically and one horizontally. The Sentech version uses only vertical spreaders, but uses two side-by-side for each loop element, and the spreaders are made of thick Plexiglas. Despite the variation in materials used, Sentech hasn't notably changed Overbeck's original director lengths or spacing pattern. Both the original Quagi and the Sentech model use eight elements on a 14-foot boom. The main difference is that the Sentech is designed to last a long, long time, even in Florida hurricanes!

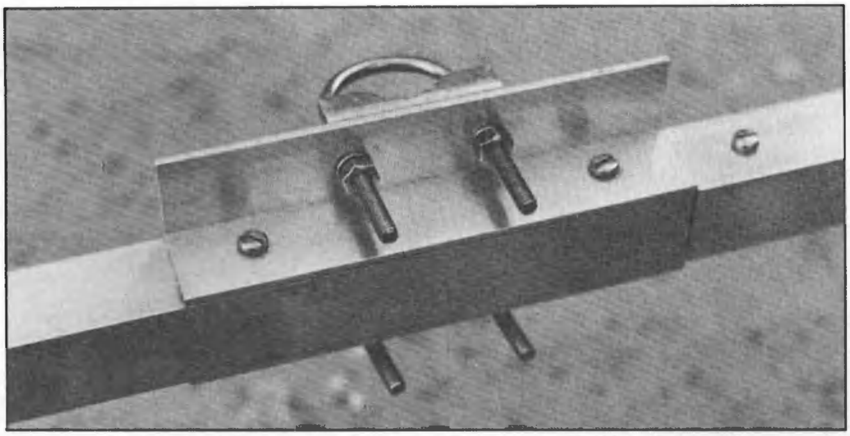


Photo D. Detail of the boom-to-mast bracket of the Sentech Q144-8. The brackets are aluminum stock, held in place by two stainless steel machine screws each. The screws are threaded into tapped holes in the boom.

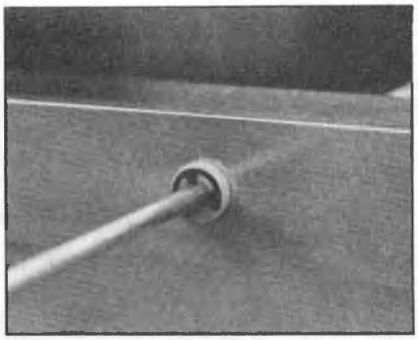


Photo E. Close-up detail of one of the director element attachments to the square boom. Two Delrin shoulder washers, firmly clamped in place by spring steel retainer washers, attach each of the directors.

Assembly

After shooting the requisite photographs of N6NB holding parts of the Sentech product (see Photo A), I took it all home and assembled it in my garage. The Quagi goes together in about 30 minutes and the piece parts are of very high quality. However, their assembly directions leave something to be desired. The directions state, "A letter is stamped on the boom on the adjacent sections," when in fact, no letters are stamped or imprinted anywhere. This might leave some neophytes scratching their heads about how to assemble the boom properly, although I figured it out. Then, while the directions are quite clear about how to install the director elements, there is no dimension chart anywhere to help one confirm if he is really putting it together correctly. The addition of a simple dimension chart, indicating all element lengths and spacing between elements, would be very helpful.

Then, the directions state, "All the spreader bars are the same overall dimensions," (true), and "The spreader bars for the driven element, however, have the mounting holes closer to one edge, while the spreader bars for the reflector are symmetrical," (untrue—there's no difference). Also, the quad loops each arrive in two pieces which must be assembled by the user. This requires a 5/64" Allen wrench, a 10-cent tool that many folks won't have laying around. It would have been prudent for Sentech to include one with the antenna. Also, the directions have a typo which states, "remember, the smaller ones are for the director," referring to the size of the quad loops. This isn't true: There are no director loops. They meant to say, "driven element."

The quad loop "spreaders," which support the loops and mount them to the boom, are attached with just one #10-24, 2" stainless-steel machine screw each. This allows the loop elements to "rock" back and forth, since a single-point mounting offers no resistance to angular changes. Sentech recommends, "Place a small amount of RTV (silicone caulking) on each side of the boom adjacent to the mounting hole. This will seal the hole and prevent the spreader bar from rotating." I did this, and it worked. But if a small amount of RTV is required for assembly, Sentech should supply a small tube of it with the antenna since, again, this is something many users won't have laying around. Better still, it would have been nice if Sentech used two machine screws to hold each spreader in place against the boom; then, it couldn't rotate at all and you wouldn't need the RTV.

The directions go on to say, "The optional antenna connector assembly . . . " (an SO239 UHF receptacle mounted in a small box at the feedpoint of the driven element loop), whereas the connector appears to be standard (my antenna came with one, and I didn't ask for it). The factory-supplied connector is a good idea, as it is difficult to solder to aluminum and most users would have no other way to connect their transmission lines. However, the factory-supplied connector attaches to the open ends of the driven element loop with small aluminum clamps screwed into a molded block assembly, and no matter how much I torqued down those screws, I couldn't make the connections tight. I had to take the aluminum clamps off the block, reform them to make them fit snugly around the 3/16" aluminum rod from which the loop is constructed, and try again. I finally got it reasonably tight. Since this is an aluminum-to-aluminum joint which will conduct a lot of RF current, it would be wise to add a coating of "Noalox" or "Oxguard," or some similar anti-oxidation compound, to these connections prior to assembly and tightening. The slightest amount of oxidation at these connection points will degrade performance, as aluminum oxide is not a good conductor. Again, I think Sentech should supply a small tube of such a compound with the antenna and recommend its application for all but temporary installations.

The Final Product

Despite the foregoing complaints, the antenna assembled well and yielded a professional, finished appearance. The materials are surely as good as those used in any commercially-manufactured VHF antenna I've ever seen, and are better than some. If Sentech would revise their instructions (see Note 1) and include the dimension chart, Allen wrench, RTV and anti-oxidation grease with the product (even if this raises the price a bit), I think users would be happier.

I did note that the factory-supplied-and-installed boom-to-mast bracket does not allow its movement along the boom, nor rotation to allow for vertical polarization of the Quagi. I guess the Sentech Quagi is designed for SSB-CW users only, since almost all FM work is vertically polarized. A shame, since the Quagi does lend itself well to FM use and will outperform many of the "FM yagis" sold (see Note 2). My objection to the stationary bracket is that, while the bracket is preinstalled in the proper position to balance the antenna when a simple RG8/U-type transmission line is attached, it would not be in the proper position to balance the antenna if a larger, heavier feedline were used. (RG17/U, for example, is pretty popular with weak-signal VHFers. It weighs about four times as much as RG8/U and has correspondingly

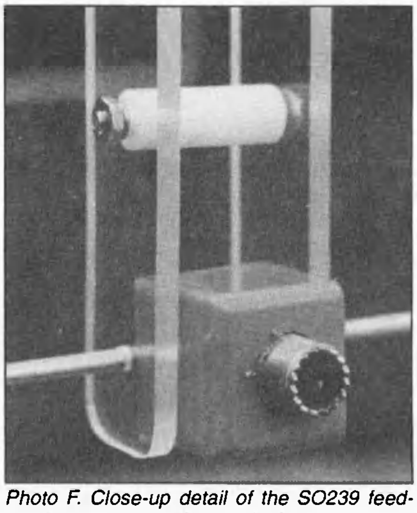


Photo F. Close-up detail of the SO239 feedpoint assembly of the Sentech Quagi driven element loop. The white ceramic spacer bolted between the two Plexiglas spreaders are also shown.

lower loss, and its use would unbalance this antenna.)

Operation

How does the assembled antenna work? Like an F16 among B29s! Lacking a professional antenna range to make accurate gain measurements, I can't offer any. But I can say that the Sentech Quagi dramatically outperforms the 2 meter yagi antenna I replaced on the same mast, using the same coax. The old "reference" antenna was a nine-element Tonna F9FT yagi (made in Reims, France) on a 12' boom. These are very popular in Europe; not so much here in the States. But years ago I compared the nine-element F9FT "Tonna" antenna to a popular brand-new 11-element, American-made yagi on the same boom length, and the French antenna outperformed the American product in every way: better forward gain, better front-to-back ratio, less pronounced sidelobes. So, I'll go out on a limb and say that the Sentech eight-element Quagi is clearly superior to any 12' yagi well as my home-brew, bamboo-boom versions, but is far more rugged, and I don't anticipate any problems with it for years to come (see Note 3). Sentech also makes Quagis for 222 and 432 MHz, and they are likely to be fine products as well. I'm thinking of buying the higher-frequency versions myself.

The last obvious question is: Will the eight-element Quagi outperform a 13-, 14- or 15-element yagi? The answer depends on the boom length and design of the yagi in question. Many yagis are built on booms too short to take advantage of the quantity of directors used. In these cases, the element count can often be reduced without impacting performance. (More elements must sound better in the advertisements, I guess.) It has been my observation that the eight-element Quagi seems to perform about equally to a well-designed yagi having a 16- to 21-foot boom length (for 144 MHz), regardless of the number of elements used. Considering that the Quagi is only 14 feet long, that's not bad. 73

"The Sentech appears to work as well as my home-brew, bamboo-boom versions, but is far more rugged, and I don't anticipate any problems with it for years to come."

made by anybody. Of course, it should be: It's two feet longer, and has the advantage of that full-wave driven element and reflector.

My reference signals for making this comparison are local beacon stations, ranging from about 30 to 200 miles from my home station. I took daily data on their signal strengths for about one week prior to replacing the antenna. Now I've taken daily data on the same beacons for one week again. They range from 4 dB to 11 dB stronger, depending on which beacon I tune in, on the Quagi. This data is "normalized," and averaged over a period of one week to help dampen the variations in propagation. Not one single beacon station is weaker with the Quagi: They are all stronger, by varying amounts. And the Quagi is installed the same height above ground, on the same mast and rotator, and connected to the same coaxial feedline, as the old antenna was. Not the most scientific test in the world, but the best I could do.

The Q144's VSWR is excellent, dipping to less than 1.2:1 at 144.5 MHz, and rising to about 2:1 at 148 MHz. It is clearly optimized for the low end of the 2 meter band. Prospective FM users who modify the mast-mounting arrangement to accommodate vertical polarization might want to reduce the driven element and reflector loop lengths very slightly to favor the 146 MHz area.

In all, I'm very impressed. I've built perhaps a dozen Quagis over the years, and they all worked well—better than similarly-sized yagis of any brand—but none were robust enough to install permanently in a high-wind region. The Sentech appears to work as

Notes:

1. After reading a preliminary copy of this article, Sentech agreed to make changes in their assembly instructions. I have since received the revised instructions and they are much improved.

2. Sentech does offer an "FM" version of the Quagi, set up for vertical polarization and tuned for the FM subband. They are also considering design changes to allow easy polarization changes in the field, by the user.

3. N6NB stated that, in his opinion, the use of Plexiglas spreaders for the loop elements is unwise as all forms of Plexiglas, even those which contain "UV blockers" or "UV stabilizers," deteriorate with age and ultraviolet radiation from the sun. Plexiglass also does not hold up well in freezing/thawing cycles, such as when covered with ice which melts and then reforms. I discussed this at length with Sentech and determined that they use genuine Plexiglas, made by Rohm & Haas (Bristol, PA). The manufacturer has supplied us with sufficient data to allay any fears I might have had about the operating life of their material in the weather, including strong, direct sunlight. Sentech advised that they looked a long time for a more resiliant substitute for Plexiglas but couldn't find one. Time will tell if the Plexiglas used will survive prolonged exposure, but even if it is only as good as the other plastic insulating materials used in competitive amateur antenna products, it should last several years.

73 Review

Number 11 on your Feedback card

by Don Johnson K7UGQ

Radio Shack/Tandy Corporation
500 One Tandy Center
Fort Worth, TX 76102
Catalog No.: 21-543
Price Class: $80

Radio Shack's DSP-40

A low-cost Digital Signal Processor you can add on.

When my wife visits our local mall's book emporium, it has become an unspoken "OK" for me to stop in to check out the new goodies at Radio Shack. I guess you could say they know me. Like a "regular" visiting the local watering hole, I'm usually greeted not only by the proprietor but also by some of the patrons! During my visits, I'm always on the lookout for new communication gadgets, especially those that may have applications in ham radio. The latest visit didn't disappoint me, as the manager was in the process of placing a "New Item" sticker on a small black plastic box in the display case. A closer look revealed a Digital Signal Processor, or DSP-40 noise reduction device.

Since moving to New England I've discovered that noise on the ham bands and shortwave broadcast bands can ruin an otherwise fun hobby. Thunderstorm static all but eliminates any communication activity until after the storm is long gone. In addition, my local power company, in spite of their denial, has several leaky power insulators in my neighborhood that generate some real havoc when they get wet. So, out came the plastic money and home went the DSP-40 unit for a test.

Housed in a plastic case, the DSP-40 measures approximately 2" x 5.5" x 7". The almost 1.5 pound unit contains the electronic noise reduction circuits, an audio amp, built-in speaker, and associated switches, indicators and a volume control.

Digital Signal Processing, unlike passive inductors and capacitor filters, uses computer technology to digitize analog audio output. Once digital, it's fairly easy to identify the noise culprit and filter, clip, or otherwise eliminate any fractional portion of the signal, and reassemble the signal back to analog for playing through speakers, sans the noise. Several manufacturers of high-quality receivers and transceivers are currently including or offering as an option DSPs with their top-line radios. While low- and middle-line radios rely on less effective passive notch filtering and bandpass filters to help reduce received noise.

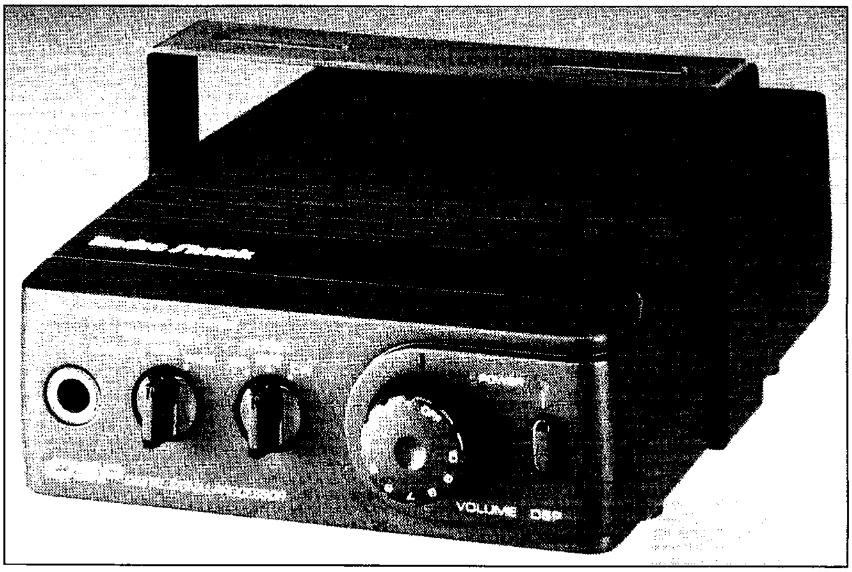
The Radio Shack DSP-40 is an audio (not intermediate frequency) device that offers selectable low-pass noise reduction filters. What this means is when plugged into the earphone or audio out jack of a receiver, not only does the received noise disappear but also those annoying heterodynes from adjacent ham and foreign broadcast stations. In addition, three levels of CW and SSB bandpass filtering can be switched in from front panel switches.

Mode	**Selectivity**	
CW	Wide	1000 Hz
	Med.	500 Hz
	Nar.	300 Hz
SSB	Wide	2700 Hz
Med.	2100 Hz	
Nar.	1200 Hz	
NR (noise reduction)		2700 Hz

To compensate for reduced volume levels as a result of inserting the various filters, a 6 watt amplifier is included.

I immediately attached the speaker-out cable from my IC-735 transceiver to the input jack on the rear apron of the DSP-40, connected the power and turned the unit on. My enthusiasm was quickly suppressed when all I could hear was severely distorted audio. Regardless of what switch was toggled, everything was a blur to my ears. Should things not go as expected, shut everything down and begin reading the 10 printed pages of the manual. I soon discovered that I was overdriving the DSP-40 with the volume control on the transceiver. A quick retest verified that you must not exceed the input level threshold or distortion will occur. This limitation proved to be an impediment some may not be able to live with. More on that later.

Further testing with the IC-735 produced only subtle results. The excellent notch filter and bandpass filter on the IC-735 was able to accomplish much the same thing the DSP-40 was providing. Later that evening, I discovered the value of the DSP-40's ability to eliminate 80 meter heterodynes. Maybe now I can hear all of the local swap net without adjacent frequency jamming! Next, I connected the DSP-40 to an older transceiver, a Drake TR-4. Voilà! The DSP-40 worked beyond my expectations. Heterodynes and the familiar "rushing" noise found on 80 meters could be virtually eliminated without any noticeable loss of received signal. Now, this is what I wanted and was anticipating. After all, the manual did state that heterodyne rejection is 40 dB. When using earphones while copying code in the crowded 80 meter Novice portion of the band the unit did even better. Static burst, however, could not be eliminated, or for that matter reduced, by any appreciable amount.



Pleased with its performance with heterodynes on an older transceiver, I installed the DSP-40 in the family car. After all, it comes with a mobile bracket and mobile power adapter. Armed with the IC-735, a 2 meter FM transceiver and a standard AM CB transceiver, I began a four-hour trip to upstate New York. This time I met with real failure. The sensitive audio drive requirements prevented me from developing enough volume to hear anything but the strongest of signals. I attached a speaker specially designed for mobile use, with the result again being low volume. The only way I was able to obtain sufficient audio level was to close all windows, thus eliminating the wind rush noise. This may not be acceptable to those without air conditioning.

Well, with windows rolled up, I attempted to contact several hams on the HF rig. No way! It seems that when I operated on 40 meters (7 MHz), RF feedback caused the DSP-40 to emit an excruciating scream, instant oscillation. Since this was not a problem with the station in my shack, my mobile installation may be suspect. Next I tried the 2 meter rig. No oscillation; however, an annoying low level hum was evident while transmitting. The CB rig didn't present any problems.

Does the DSP-40 work? Yes, with some reservations. If you plan to use earphones with the DSP-40 attached to older receivers/transceivers (those with fixed selectivity), and at a well-grounded base station, I'd say it works very well. I installed a double-pole, single-throw switch to completely bypass the DSP-40 when its service is not desired. This eliminates the internal amplifier completely, giving me normal sounding audio. When needed, I flip the switch. When compared to other digital processing units currently on the market, the DSP-40 offers a reasonably-priced solution to an annoying problem.

Radio Shack should consider incorporating some RF bypassing, and better audio recovery circuits. Note: I tried some random capacitors in the audio output line and was able to reduce (but not elimiate) the RF feedback problem. However, placing four ferrite chokes on each audio and power line did not seem to offer any help.

During a recent telephone conversation with Radio Shack engineers in Ft. Worth, Texas, the feedback problem was discussed. It appears that feedback similar to what I experienced may not be unique to the DSP-40. Further testing revealed that separating the DSP-40 and my IC-735 six to eight inches eliminated the squealing. Further experimentation revealed that when the DSP-40 was mounted directly on top of the transceiver and directly over the RF section, the feedback could be made to disappear.

Cheap Dual-Band Yagi

A fine VHF/UHF beam made from old TV antennas.

by Marty Gammel KAØNAN

Last summer I was looking for a dual-band (2 meters and 70 cm) yagi antenna. I looked at the commercial designs available and felt that they had too many design compromises. The commercially-made antenna was a five-element 2 meter yagi with a gamma match, mounted on one side of the boom, and a five-element yagi for 70 cm on the other. I felt that there was too much interaction between the elements of the two antennas, because they were side by side on the same boom.

The design I decided to make was a five-element 2 meter yagi, having about 9 dB of gain, with a six-element 70 cm yagi directly in front of it on the same boom. The six-element yagi would have about 10 dB gain, and both should have excellent front-to-back ratios. For the 2 meter beam, I used a design I had published in the December 1993 issue of *73 Amateur Radio Today*. I am very happy with the excellent performance of that design, and will explain just how to combine the VHF beam and UHF beams, one in front of the other. For the 70 cm version I readjusted the director spacings, and added another director to give some extra gain. I like using a "T" match balanced feed system rather than a gamma match. The gamma match system can skew the pattern of an antenna, while the "T" type balanced feed system gives a straight, more symmetrical pattern of radiation.

People give me their old TV antennas and I strip off all of the pieces of aluminum tubing that are usable. These I save for future projects. (Only the short or bent pieces of tubing and the plastic parts are not reused.) This project uses a square boom that is 80" long. If you have a longer one, you can cut it down to size.

Our friendly local Amateur Radio Consignment Center was my source for the 3/16" aluminum tubing. Only $2 for a 12-foot long piece (such a deal!). Almost enough to make two UHF beams. I chose to use BNC chassis mount connectors on this project; you may want to use SO-239 or N-type connectors instead. I used two different styles of panel mount BNCs in this project. Use the type you prefer. My neighborhood hardware store had a good supply of 3/16" pushnuts, just the thing for attaching the UHF elements to the boom.

Radio Shack is my source for the plastic boxes needed to hold the balun assemblies.

With some good luck scrounging, this dual-band VHF and UHF antenna can be made for about $10. You may want to purchase a duplexer for about $30, to allow you to run a single feedline to your dual-band radio. (More on this later.)

I referred to the *ARRL Antenna Book*, 15th edition, for the proper way to make the balun. They are easier to make than you think. Due to our harsh winters, I needed to enclose the baluns, and I also needed good solid mounts for the "T" match feedpoints. I chose plastic project boxes from Radio Shack. The box that measures 2-1/2" by 4-3/4" by 1-1/16" (Radio Shack project box #270-222, $2.59) will house the balun for the 2 meter portion of the antenna.

For the 70 cm balun, I chose the Radio Shack project box # 270-220 that measured 2" by 4" by 1", for $1.99. The beam itself was easy, using an 80"-long square boom from an old TV antenna as a starting point. On the 2 meter portion of the antenna, I used 3/8" diameter aluminum tubing for the elements and "T" match bars. To further im-

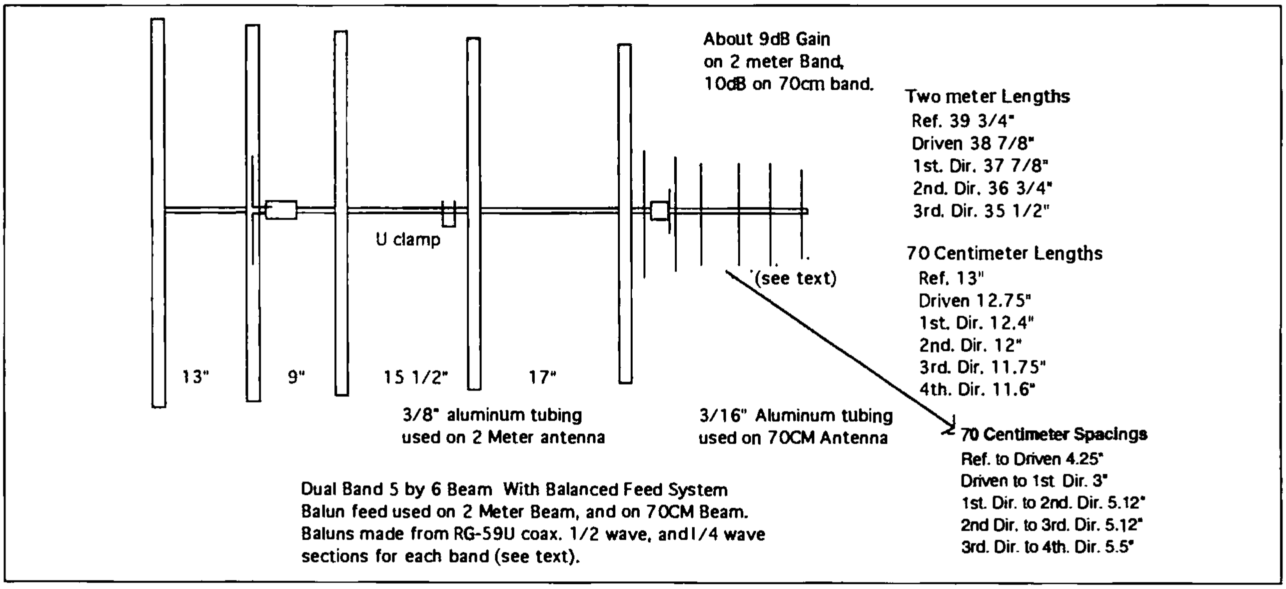


Figure 1. The Dual-Band Yagi has an 80" boom length.

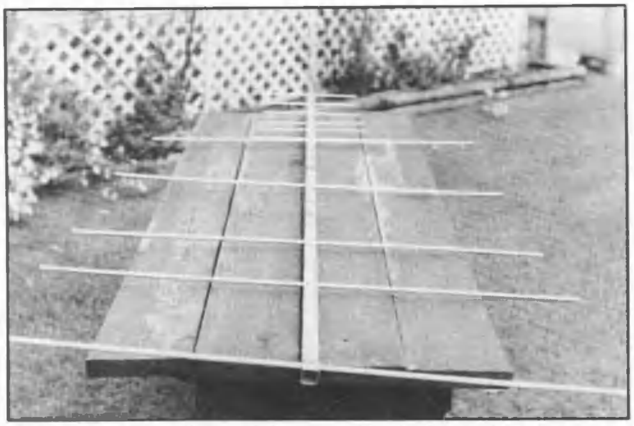


Photo A. Overall view before installing baluns and U-clamps.

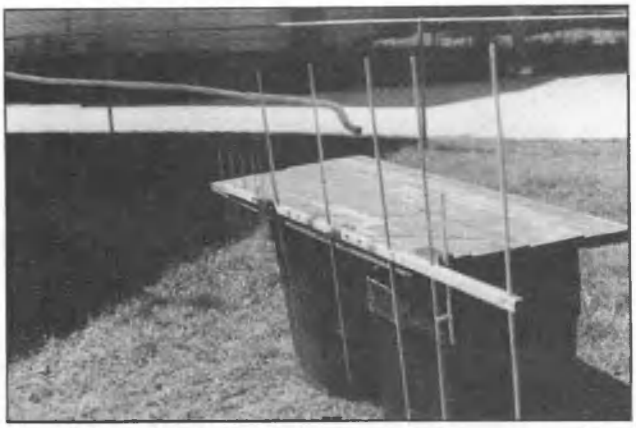


Photo B. Overall view showing baluns installed on opposite sides of the boom, ready for tuning.

prove the design features of this antenna, also from the *ARRL Antenna Book*, I added a ferrite bead choke on the quarter-wave RG-59U line section of the balun. The local electronic surplus house proved to be a cheap source of ferrite beads. I also wound the half-wave RG59-U section of coax into a four-turn choke to fit into the plastic box on the 2 meter section of this dual-band antenna. The combination of the ferrite beads and the four-turn choke provide feedline isolation, and avoid radiation from the feedline shield. The dimensions for the "T" bars came from standard design lengths for gamma match parts.

On the 70 cm section of the antenna, I again made up a half-wave section of RG-59U coax, and also a quarter-wave section of RG-59U coax to form the balun, using more ferrite beads on the quarter-wave section.

Assembly

See the Parts List. Once you have all the needed pieces, you can begin to build the beam.

Once all the old elements have been removed from the boom, mark where you need to drill to mount the five VHF elements. I found that by mounting the elements in the upper third of the boom (about 1/4" in from edge) the spacing for the "T" bar straps was more manageable; all the elements' centerpoints line up, and the beam will look better. I scribed a line along the length of the boom to mark the centerline for drilling the element mounting holes. If you can use a drill press to drill the element holes, they will be square to the boom. After the holes are drilled, try fitting the 3/8" tubing in each VHF element hole, and the 3/16" UHF elements in their holes. Check for squareness to the boom with a square.

The spacing for the elements, center-to-center on the 2 meter portion of the antenna, are: reflector to driven element, 13"; driven element to first director, 9"; first director to second director, 15-1/2"; second director to third director, 17". On the 70 cm portion, after a 1" space from the 2 meter antenna, the reflector to driven element spacing, center to center, is 4-1/4"; the driven element to first director, 3"; first director to second director, 5-1/8"; second director to third director, 5-1/8; third director to fourth director, 5-1/2".

Cut all the elements to length and flatten one end of each of the two 6-1/2" match bars. Flattening about 1/2" will do (see photo/drawing). Drill a 1/8" hole in the flattened area, and round off the corners (see Figure 2). Attach all five elements to the boom using the 1" stainless steel screws.

Now drill the holes for mounting the BNC-type panel mount and the 1" #8 bolts in the plastic box, and attach the mount with three of the four bolts. (The fourth bolt will attach the coax shield of the quarter-wave section on the balun later on in the construction of the antenna.)

For UHF make the 3/16" match bars 3" long, flattening about 3/8" on one end of each bar. Use a 5/64" drill bit to drill the holes for mounting the bolts on the UHF balun box, and for drilling through the match bars.

Making the Choke and Balun Assembly

Start with the 2 meter balun first, using a piece of RG-59U about 14" long for the quarter-wave section, and prepare both ends as shown in the drawing. Do the same to a 26-1/2" piece for the half-wave balun section. Allow 3/4" on each end of both coax sections for dressing the ends for use. Wind the longer section of coax into a four-turn coil. Tape the coil temporarily in a couple of places, just to hold it until the finished balun

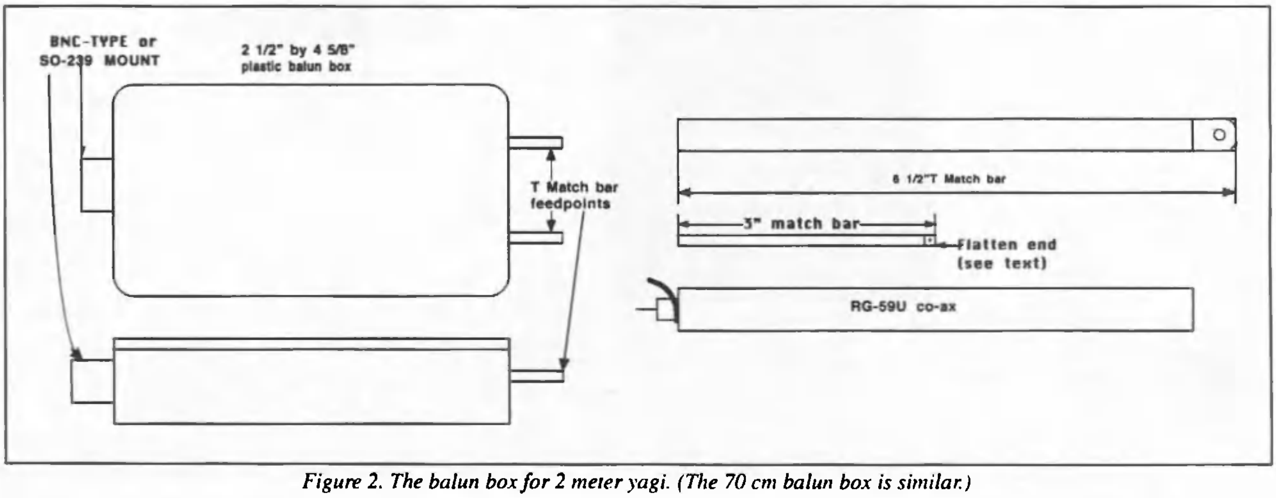


Figure 2. The balun box for 2 meter yagi. (The 70 cm balun box is similar.)

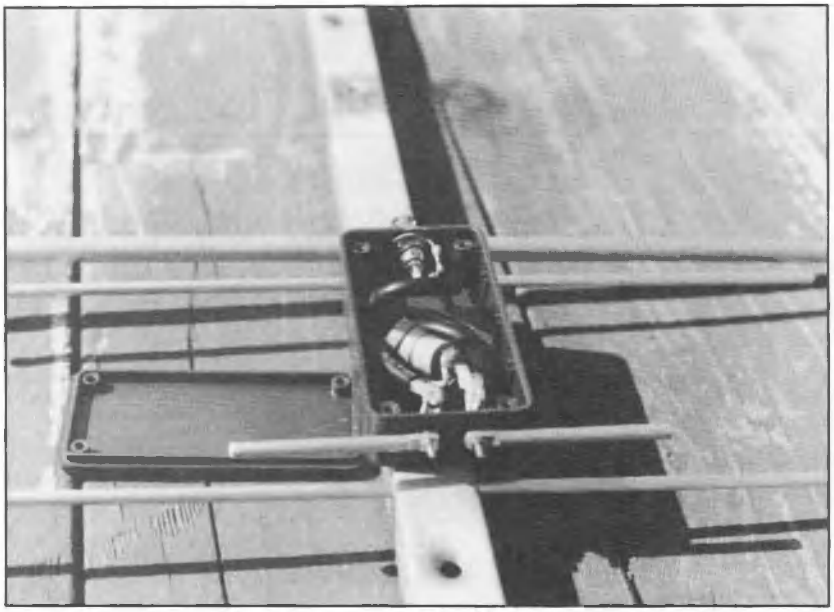


Photo C. Placement of 70 cm balun on boom.

is installed in the larger plastic project box #270-222. Solder the shields from both sections of coax together. Install the balun assembly in the balun box. Be certain that all connections are correct. On the VHF balun, install the closed-end crimp-type connector on each end of the center conductor of the half-wave coax. Install the 1" #8 bolts through the crimped connectors using washers, and apply a washer and nut to the outside of the plastic box. After doing this, remove the tape from the coil. Install as many ferrite beads as you have room for on the end of the quarter-wave coax section (I had room for six ferrite beads). Solder a closed-end crimp-type connector to the shield and then connect it to the fourth mounting bolt for the BNC-type panel mount fittings. Solder the center conductor to the center terminal of the BNC. Apply Crystal-cote or some other type of sealer to everything in the balun box.

To make the UHF balun assembly, cut an 8" section of RG-59U coax for the half-wave section, and form it into a loop that will fit in the smaller #270-220 project box. Cut a 4" section of RG-59U coax for the quarter-wave section. Solder the shields from the half-wave section and one end of the quarter-wave section together. Put the remaining four ferrite beads on the other end of the quarter-wave section of RG-59U coax.

The Mystical, Magical "T" Match Bars

Attach the "T" match bars to the balun boxes. Cut and form 3/8" wide straps around the driven elements and match bars. You will need two pieces about 4-1/2" long for the VHF straps, and two pieces about 2-1/2" long for the UHF straps. Then drill holes to bolt the straps to the tubing. You will need about 1-3/8" between the "T" bars and the driven element on the VHF section. Spacing for the strap should be about 4" from the center of each 1" #8 stainless steel bolt on the balun box. On the UHF section you will need about 5/8" spacing between the driven element and the "T" bars; the straps should be about 1" from the end of the match bars. Drill a weep hole in the lowest corner of the balun boxes for drainage once the boxes have been mounted on the boom. At this point add a ground wire from the BNC-type connectors to the boom.

Check all connections, nuts, bolts, and screws and then mount the antenna on a *non-conducting mast*, ready for tuning. Most antenna companies neglect to tell you that a metal mast is seen by the antenna as an out-of-place element that will detune the antenna. Tape the coax to the boom and bring the coax down the mast, away from the antenna.

Tuning the Completed Antenna

Tuning the antenna is easy. Do the 2 meter section first, then the 70 cm section. Connect a coax, SWR meter, and your radio to the antenna. Check the SWR at the top, center, and bottom of the frequency area of design. By noting the pattern of the SWR curve, you will know whether to move the match bars in or out for the best match. Move them only about 1/8" at a time, rechecking the SWR curve as you go.

Mine was very close to the center of the designed-for frequency, and only had to be adjusted about 1/8" from the text. Be sure to make all the adjustments of the straps on the "T" bars equal.

Dual Feedlines or Single-Feedline

Now is the time to decide whether or not to use a duplexer and phasing lines cut to half-wave multiples, or a single feedline. If you have a dual-band rig with one connection for a single feedline, and no internal duplexer, a duplexer system is necessary. I have single-band rigs and plenty of hardline, so for me dual feedlines were not a problem. To make up dual-phased lines to go to a duplexer, find the velocity factor of your coax, and use a half-wave for 2 meters and three half-waves for 70 cm. Attach the duplexer at this point. You will still want to do your preliminary tuning of the antennas separately, then with the duplexer installed, with its phasing lines installed as a final check.

Builder's Notes

If you are going to use the single feedline system, and your duplexer is built-in on your radio already, you may try using a "T" fitting to join the feedlines at the antenna (see text). Except for buying the ferrite beads and the plastic boxes to make clean, neat weatherproof feedpoints, all the 3/8" aluminum came from my stockpile of old TV antenna parts, and the 3/16" aluminum tubing came from our friendly local Amateur Radio Consignment Center. All the hardware is common, and can be bought from any local hardware or building supply store.

I cut all the aluminum to length with a common plumber's tubing cutter. It gives a more finished end than if you cut it with a hacksaw. Each VHF element is installed through the boom, and fastened with a 1" #8 stainless steel screw. Be careful not to over-tighten these screws because you may bend the element.

Mark the UHF elements for the depth needed to attach the 3/16" pushnuts. I used a piece of the 3/8" tubing to push the pushnuts onto the elements. If you cannot find an old TV boom, most local scrap metal dealers will sell aluminum square and round tubing.

When you are cutting the coax be careful to measure the lengths, and to check the velocity factor for the coax you use. My

Photo D. Placement of 2 meter balun on boom.

Parts List

80"-long 1"-square aluminum boom (old TV antenna type)		
2-1/2" x 4-3/4" x 1-1/16" plastic project box		Radio Shack #270-222, $2.59
2" x 4" x 1" plastic project box		Radio Shack #270-220, 1.99
Piece of scrap sheet aluminum, brass, or copper (for match bar straps)		
10	Ferrite beads (to make the ferrite chokes) (see text)	
12.5" section of RG-59U coax (finished length) (see text) VHF		
25" section of RG-59U coax (finished length) (see text) VHF		
8" section of RG-59U coax (finished length) (see text) UHF		
4" section of RG-59U coax (finished length) (see text) UHF		
2 pieces	3/8" x 6-1/2" aluminum tubing (VHF "T" match bars)	
1 piece	3/8" x 39-3/4" aluminum tubing (VHF reflector element)	
1 piece	3/8" x 38-7/8" aluminum tubing (VHF driven element)	
1 piece	3/8" x 37-7/8" aluminum tubing (VHF first director)	
1 piece	3/8" x 36-3/4" aluminum tubing (VHF second director)	
1 piece	3/8" x 35-1/2" aluminum tubing (VHF third director)	
2 pieces	3/16" x 3" aluminum tubing (UHF "T" match bars)	
1 piece	3/16" x 13" aluminum tubing (UHF reflector element)	
1 piece	3/16" x 12-3/4" aluminum tubing (UHF driven element)	
1 piece	3/16" x 12-3/8" aluminum tubing (UHF 1st director)	
1 piece	3/16" x 12" aluminum tubing (UHF 2nd director)	
1 piece	3/16" x 11-3/4" aluminum tubing (UHF 3rd director)	
1 piece	3/16" by 11-5/8" aluminum tubing (UHF 4th director)	
2	#8 by 1" flat head bolts for attaching "T" match bars to VHF balun box	
5	#8 by 1" flat head self tapping stainless steel screws (for VHF elements)	
4	#8 by 1" flat head self-tapping stainless steel screws (for balun mounting)	
4	#6 by 3/8" flat head bolts with nuts & washers (for VHF BNC fitting)	
2	BNC panel mount fittings (for feedline attachment on balun boxes), SO-239 or type N connectors may be substituted (your choice)	
4	#6 x 3/8" flathead stainless steel bolts with nuts & lock washers	
6	Crimp-type closed-end connectors (for coax connections inside baluns)	
12	3/16" flat push nuts (for attaching UHF elements to boom)	
8	1/2" long 2-56 nuts and bolts (for attaching UHF balun) parts, and match bars (see text)	Radio Shack
2	3/4" long 2-56 nuts and bolts (for attaching UHF balun) parts, and match bars (see text)	Radio Shack
1	VHF-UHF duplexer (optional; see text)	

You may have to find a few assorted bolts and washers in your junk box to complete this antenna. (See text.)

Tools List

Electric drill
3/8" drill bit (for holes in boom for VHF elements)
3/16" drill bit (for holes in boom for UHF elements)
1/4" drill bit (for removing old elements from boom)
5/32" drill bit (for #8 screw holes)
Tin snips (for cutting match bar straps)
Electrical tape
Waterproof sealer (for baluns; can be spray or brush on)
Aluminum, copper, or brass sheeting (for "T" bar to driven element straps)
Drill press for drilling all holes (optional)
Solder and soldering gun (for crimp type connectors inside balun boxes)

RG-59U had a velocity factor of 66%. The number of ferrite beads is not that critical, but they do stop radiation back down the coax shield.

Be sure to drill or file the hole for the center of the BNC panel mount just big enough, but not so big that you get a sloppy fit (I had to use a butyl rubber caulk on my VHF balun box because of this). It does have to seal out the weather. Tune the antenna before you weatherproof and seal up the plastic balun boxes, in case you may not have wired the connections right. Make nice neat pigtails on your coax ends so that they will be easier to attach.

73s, and I hope that you enjoy this antenna project. If you have questions, you may write to me (please enclose an SASE #10 envelope for a reply): Marty Gammel KAØNAN, 1703 Hewitt Avenue, St. Paul MN 55104-1128.

Grounding and Lightning Protection, Part 1

Protect your shack and yourself from lightning.

by Glen E. Zook W5UOJ

Is there really a true "science" of grounding and lightning protection? For many of us ham radio operators, grounding seems to be more of a "black art" than science. Maybe the best way to appease the radio gods would be to try a few incantations over a boiling caldron!

Now, if you believe all that, I have a bridge in Brooklyn you may be interested in! Actually, there is a kernel of truth in the above paragraph, for many things which do not seem plausible are truly affected by grounding.

First of all, the grounding requirements due to the presence of radio frequency energy are different from those required for lightning protection. Thus, two different grounding systems are needed for the vast majority of amateur radio installations: one for RF grounding and one for lightning protection.

This month we will take a concerned look at lightning; in the second part of this article, next month, we will look at RF grounding.

Protecting Yourself

At present, there are two different schools of thought on the subject. The first is to take all necessary precautions to prevent the strike; the second is to ground the heck out of everything so that if you take a strike there is sufficient protection for your equipment. Frankly, I believe in both: Take all the necessary precautions and then ground everything!

Many lightning "experts" believe that all a lightning rod does is *attract* lightning. A close parallel in the amateur radio world is the amateur with the lowly(?) ground plane or vertical antenna. On the surface, it would seem that lightning would strike this unobtrusive antenna less often than it would a large yagi array. In fact, the opposite is true!

Lightning does not start from the sky and travel downward. It appears, especially from a distance, to travel in a downward motion, from the sky to the earth, but it actually starts from the ground up. As a charged air mass (usually clouds) comes into an area, the possibility of an article on the earth gaining enough charge for a lightning strike increases enormously. The causes of this static build-up are varied, but include things like the wind blowing across the antenna.

If this static discharge is not dissipated rapidly, small "lightning bolts" called feelers start coming from the end of the antenna, tower, etc. These feelers grow longer and longer, and have a duration sometimes approaching minutes rather than seconds! Finally, these feelers are met by the primary stroke of lightning coming from the sky. Yes, the vast majority of lightning's energy comes from the sky, but without the feelers coming from the ground there would be no lightning strike.

What happens with the lightning rod or, in the case of amateur radio, the vertical antenna, is that there is very little on the end of the antenna to dissipate the electrical charge. A rule of thumb is that an item will "protect" an area equal in radius to twice the height of that item. Or, conversely, the vertical or tower will draw energy from a circle on the ground equal to twice its height (see Figure 1). For example, a 30-foot vertical will draw energy from a circle 60 feet in radius (120 feet diameter). Actually,

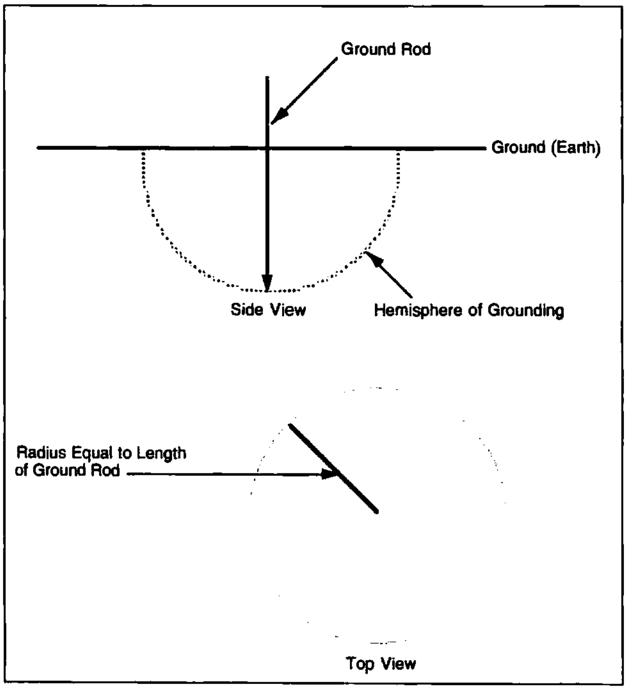


Figure 1. The hemisphere of grounding. The effective ground is equal to a hemisphere with a radius equal to the length of the ground rod.

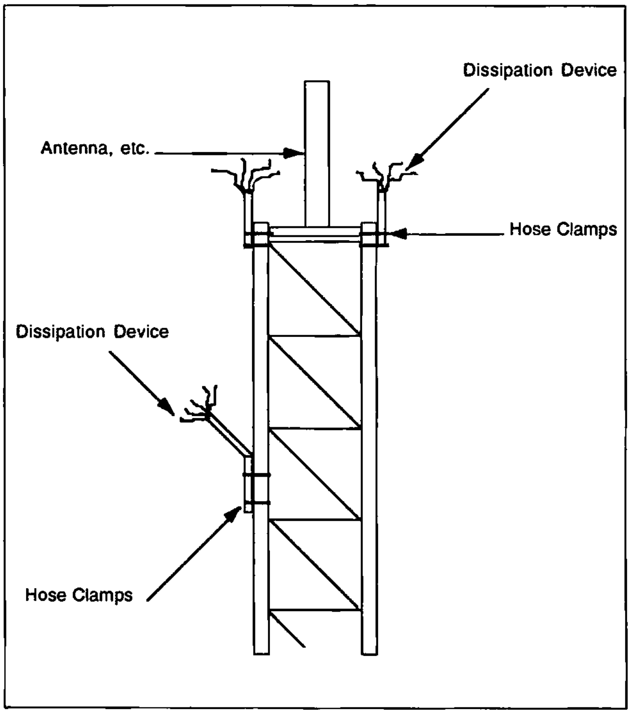


Figure 2. Placement of dissipation devices on a typical tower.

Fig. A1. The amateur radio operator adds a vertical.

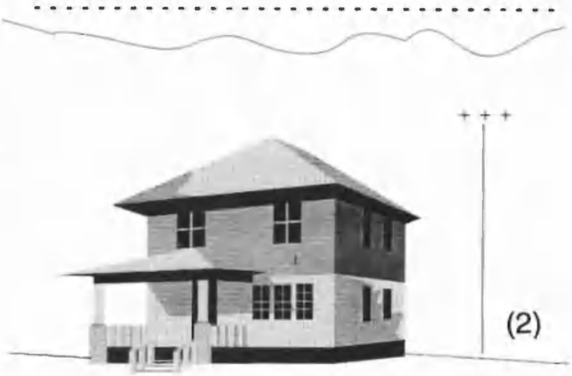


Fig. A2. As a charged mass moves closer, current flows from the earth to the antenna.

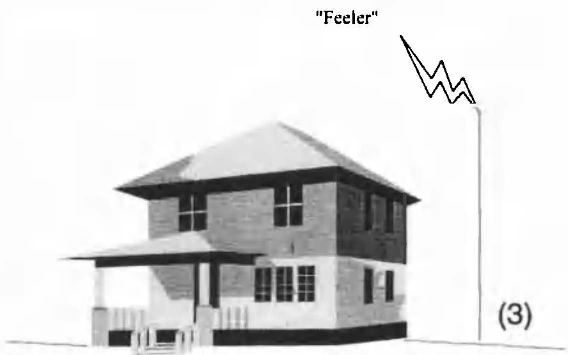


Fig. A3. As the charge increases, a "feeler" begins to form.

Fig. A4. As the "feeler" grows longer, the main charge comes from the sky.

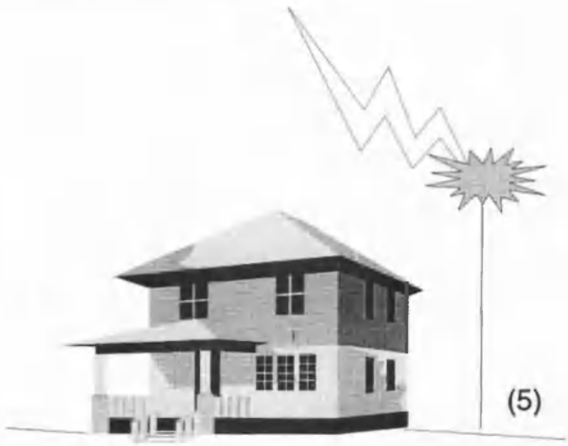


Fig. A5. Lightning strikes!

Fig. A6. The ham puts up a more complex antenna system.

Fig. A7. When a corona is present a feeler cannot form. Thus, there will be no lightning.

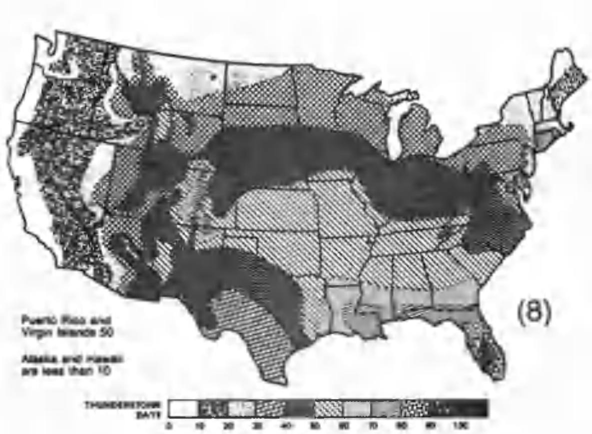


Fig. A8. Thunderstorm days (average) in the U.S. per year.

the area protected is a cone with the apex at the top of the tower (or vertical), and the base of the cone a circle with a radius equal to twice the height of the antenna.

All this energy is concentrated into a very small area. In the case of a vertical with a solid top (corona ball, etc.) this is usually in the neighborhood of a square inch or so. In the case of a vertical which ends in open tubing, the actual area is in the order of 0.1 square inch, if that! The result is a very concentrated charge, which tries to make contact with the energy from the sky. This happens whether or not the end of the antenna is insulated.

With yagis, the energy is dissipated over a much larger area. The result is that there is much less chance of gaining a sufficient level of charge to get the feelers started. In the commercial radio world there are all sorts of items available to help dissipate the charge. Many of these take the form of a spline ball or some similar arrangement.

A spline ball consists of many wires or aluminum foil strips connected to a common point. This effectively increases the area of the tower, or other antenna support, and dissipates the energy built up by static. In the case of an intense electrical storm these devices may actually glow from corona discharge. This is fine, because the energy is being dissipated rapidly and will not become a feeler.

Large yagi arrays act somewhat as a spline ball, dissipating the electrical energy rapidly. However, the higher the antenna array, the more antennas are required to dissipate the energy.

Spline balls can be bought (they cost in the neighborhood of $150 apiece), or they can be built. The key to their placement is not that they be on the highest part of the tower, but that they be located near the top. In the case of antennas mounted on top of the tower you can mount a spline ball on each leg near the top of the tower and still get excellent protection. With towers over 100 feet in height, it is recommended that spline balls be placed every 75 feet. This is to reduce the charge as it is developed along the tower.

Grounding for lightning protection actually has two functions: to allow the charge built up on the antenna a ground path, and to protect in the case of a direct strike. As stated above, if you keep the charge built up from producing feelers, then you will not take a strike.

Grounds for lightning protection must be as straight as possible from the item being protected. Very gentle arcs are a must; avoid right-angle bends at all costs. A right-angle bend places a very high impedance in the ground wire, and the lightning will often jump off the ground wire and go elsewhere! Keep the ground wire in a straight line; never loop down and back. When connecting with a ground rod, bring the ground wire into the rod with nothing between the rod and wire. Clamp it very securely or thermal-weld it in place. Never bend a ground wire over 90 degrees—the lightning will continue downward, ignoring the remainder of the wire!

All coaxial type feedlines should be grounded at three points: at the top of the tower, at the bottom of the tower, and at the entry point into the building. Ground the feedline by removing the outer covering of the coax and attaching a ground wire to the shield. There are commercial attachments made for this purpose, but simple hose clamps can be used to attach the ground wire.

After attaching the ground to the coax shield, make sure to waterproof the area. Again, there are all sorts of products available on the market to do this job. One very effective method is to use the cheap black plastic tape, available for prices like 39 cents a roll, at home handyman centers (don't buy the good, more expensive brands!). This tape, after just a few days in above-freezing weather, congeals into a waterproof mass, just what the doctor ordered for protecting the ground joint.

Keep the ground wire traveling downward in as straight a line as possible until making the ground connection to the tower, ground rod, etc. A number diagrams accompany this article to show how to accomplish the best grounds possible.

The use of "CAD Welding" or other thermal bonding techniques can be used if dealing with a solid object like a ground rod. However, *never* use these techniques when dealing with hollow objects like a tower leg. The heat generated by the thermal process causes the galvanization inside the leg to dislodge, thus setting the stage for corrosion. After a relatively short time, the tower rusts from the inside out!

When clamps or bolts are used, they should be checked every six months. Just loosen and retighten the bolt or clamp to remove any traces of corrosion which may have built up. This is not necessary with the connections made to the coax shield which have been waterproofed with the plastic tape or other methods.

Each and every leg of a tower must be grounded! This includes even small towers. Bring the grounds to separate ground rods located near each tower leg. The use of rods over five or six feet long is usually unnecessary; four-foot rods give good grounds.

The power line ground must be good. At the point at which the power line enters the building a ground should be in place on the neutral. Often, this is just a piece of #14 wire clamped to the conduit entering the meter base. This, in turn, is usually clamped to a three-foot ground rod driven into the soil at the base of the meter. Replace this wire with a much heavier wire, at least #8 or larger. Make sure the ground rod is OK, and follow the rules about no large bends in the ground wire.

Anything external to the building should be grounded, including TV antennas, metal on chimneys, etc. The idea is to bleed off any potential charges which can build into those strong enough to produce the feelers which result in lightning.

There are all sorts of devices available from commercial sources which will limit the possibility of lightning strikes. But, the pricing on these is outside the budget of all but a very select handful of amateurs. Even spline balls are expensive. However, there is a method of building suitable dissipation devices.

Dissipation Device

A simple but effective dissipation device can be made from galvanized electric fence wire, a few hose clamps, and a short piece of e.m.t. (electrical metallic tubing) conduit. The electric fence wire is available in 0.25 (1/4)-mile and longer lengths at many handyman centers. In this area the price was $8.40 plus tax for a 0.25-mile roll of 17 gauge wire. The e.m.t. conduit is about $3 for a 10-foot length of 0.75 (3/4)-inch material. This is sufficient material to make a quantity of up to 10 dissipation devices. Using a hacksaw or tubing cutter, cut the desired number of pieces either 12 inches or 18 inches long. Then, cut one end of the tubing lengthwise about 3 inches with a hacksaw. It is best to cut the tubing twice, at 90 degrees to each other, but one cut will work.

Cut lengths of galvanized wire 18 inches long. Make sure there are enough to entirely fill the end of the conduit, working in as many lengths of wire as possible. When using 0.75 inches diameter conduit you can usually get in

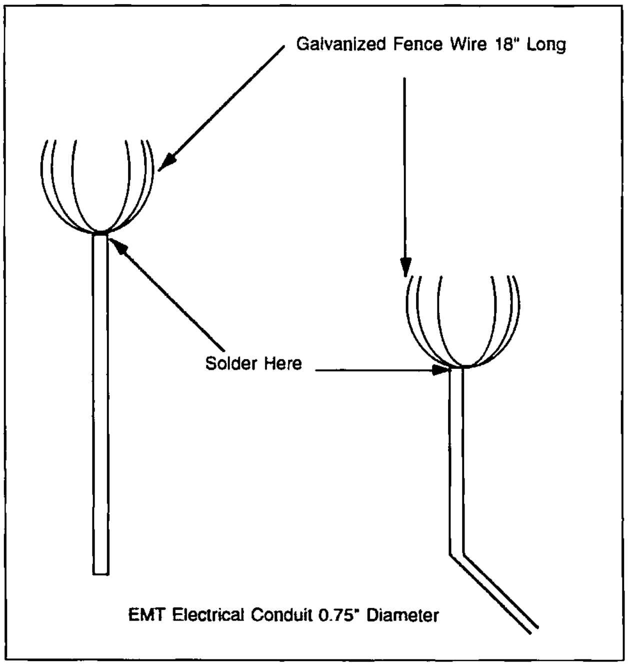


Figure 3. Diagram of a spline ball. Cut conduit 12 or 18 inches long. Split the end about 2 or 3 inches with a hacksaw. Insert wire into the conduit and secure it with a hose clamp. Solder the base of the fence wire.

at least 150 wires. If you use 0.5-inch conduit, you can get in about 75 wires. Then, secure the cut end of the conduit with a hose clamp at the very top of the cut. Next, using a propane torch and acid core solder, solder the wires right next to the piece of e.m.t.. You don't have to solder them to the conduit, but you do want to keep the wires together. Finally, flare out the wire ends to form a circle from 12 to 15 inches in diameter.

Next, this array must be mounted at or near the top of the tower. See Figure 2. If the tower height is over 75 feet, put two or more sets of dissipation devices on each tower leg, not over 75 feet apart.

When dealing with spline balls for the sides of the tower, a slight modification must be made in their construction. See Figure 3. Cut the conduit about 18 inches long instead of 12 inches. Then, at the end which has not been notched, make a 45-degree bend about 6 inches from the end. Clamp this 6 inches to the tower leg with two hose clamps. This can also be done with the devices which are installed at the top of the tower, if so desired.

Usually, the hose clamps are sufficient to make satisfactory connections between the tower leg and the dissipation device. However, ground wire (#14 is fine) can be connected between the device and a bolt holding the tower together. Drill a hole large enough to pass a #10 bolt through the conduit and attach the ground wire. Make sure the wire is connected well at both the dissipation device and the tower. You can use pieces of the galvanized fence wire for making these connections. By doing so, you will minimize the corrosion due to dissimilar metals. If you use copper wire for these connections, use a solder lug at both ends of the ground wire to prevent corrosion from the dissimilar metals.

Make sets of these devices equal to the number of legs on the tower. Usually this will mean sets of three, but in some cases sets of four. Although the use of these devices will not ensure that a lightning strike will never happen, they greatly reduce the chances (in some cases by as much as 99%) of that happening. Also, the spline balls can be used to protect wood poles by placing one at the top and running a ground wire down the side of the pole.

The devices can be attached to the tower legs by various means, including "U" bolts, muffler clamps, or hose clamps. Hose clamps are cheap and are very durable, usually made of stainless steel. These are available at any automotive store, at most discount stores, and even in some grocery stores.

Spline balls can be made from conduit which is only 0.5" in diameter. However, you should double the number of devices since they will be approximately one half the size of those made with the 0.75" conduit. Place them every 35 to 40 feet along the tower leg instead of the 75 feet placement of the 0.75" models.

Spline balls will not absolutely prevent lightning strikes. However, they will greatly reduce the probability of one because they dissipate the charge being built up on the antenna system.

There are all sorts of hints which apply to lightning protection. However, by following the guidelines outlined here you can protect yourself from virtually all strikes.

The antennas at W5UOJ consist of three towers, all on a city lot 70 feet by 130 feet. The small tower has a 440 MHz vertical with a height to the top of around 37 feet. The Hy-Gain HyTower is 55 feet tall, and the primary tower starts with a full size 20 meter 3-element at 55 feet and proceeds through 15, 10, 6, and vertical and horizontal beams for 2 meters at 67 feet. The location is just one half block from the highest point in the city, about 8 feet of elevation difference.

In over 22 years, these antennas have never been hit by lightning, even though my neighbor across the street has lost three trees and a chimney to lightning! About a year ago, the power transformer located at the back corner of the lot took a direct strike. This was about 30 feet in elevation below the top of the tower located about 60 feet away; however, the antennas were not hit.

No one can guarantee that any system is perfect. No one can guarantee that a lightning strike will never occur. But, by taking the necessary precautions to ensure that the energy is bled off, the possibility of taking a strike will be reduced greatly.

The second part of this article,dealing with RF grounding, will appear next month.

HAMSATS

Number 14 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

In the Fast Lane

February marks the fifth anniversary of the launch of UoSAT-D, today known as UoSAT-3 or UoSAT-OSCAR-14. This was the first amateur-radio spacecraft to carry an open-access 9600-bps digital trans-ponder. The RF links to and from the satellite were designed for frequency-shift keying (FSK) using 2 meters for the uplink and 70cm for the downlink. Today the satellite is only used for commercial applications on non-ham frequencies, but it ushered in an era of acute interest in amateur-radio high-speed digital communications from space.

Three satellites are currently used for 9600 bps ham operation including UoSAT-OSCAR-22, Kitsat-OSCAR-23 and Kitsat-OSCAR-25. All are in low-earth-orbit (LEO) and provide four to eight passes a day each for most earth stations. They do not operate using standard packet-radio format, but require that ground stations run specialized software on PCs and communicate with the terminal node controller (TNC) in the KISS mode.

U-O-22 is primarily used for gateway traffic. Most of the files sent through this satellite are bulletins and messages routed between terrestrial packet systems. The satellite provides an alternative to the usual shortwave connections.

K-O-23 and K-O-25 carry files posted by individuals. They act as flying mailboxes or bulletin-board systems (BBS) in the sky. Digital files of all types have been sent through these satellites. Most files are short mail messages, but many picture files using the highly compressed .JPG format or sometimes .GIF encoding have been uploaded. Voice files in either .WAV or .VOC format have been sent and many PC programs have also gone through the systems.

Just like terrestrial BBSs, if it's digital it can be loaded into the satellites, but unlike land systems, these hamsats do not have disk-drive storage. All the files are saved in random-access memory (RAM) and, due to limited storage space, will be dropped on a first-in, first-out basis.

Equipment Needs for 9600

A typical home system includes moderate to small crossed yagis or other circularly polarized antennas for 2 meters and 70cm. Right-hand circular polarization (RHCP) is adequate, but many antennas have switchers to allow left-hand circular polarization (LHCP) selection. Rotators for azimuth and elevation are needed to aim the antennas. Some rotator control boxes are configured for a computer control interface, but less expensive ones are not. Quality coax is a must at these frequencies.

Most stations use dual-band base-station radios, but lesser radios can do very well. For the 2 meter uplink all that is needed is an FM transmitter, preferably capable of 1 to 2 kHz tuning increments, with 25 watts output power. A point in the modulator section to connect the 9600 baud transmit data is required. This is usually done at the varactor diode or similar circuit just past the microphone amplifier circuits. For the 70cm receiver an FM scanner with 1 kHz tuning increments will work well. Most receivers will require a new bandpass filter to allow for the wide downlink signal and tuning inaccuracy usually caused by Doppler shift during a pass. Most ham-rig manufacturers offer 20 to 30 kHz filters for less than $10. These can be installed with little or no degradation to normal voice operation. An output line from the receiver's discriminator circuit is also needed. It is typically found on the output pin on the discriminator IC in newer radios. On older rigs the discrete discriminator circuitry can be found just before the audio output stages and routed out of the radio on a shielded cable.

Standard TNCs are usually set for 1200 baud to the radio. For 9600 work a new TNC is needed, or an older TNC can be adapted for a new high-speed modulator-demodulator (modem) circuit. Kits and complete commercial units are available from many manufacturers both for complete high-speed TNCs, or just modems. Instructions are usually included for the necessary radio modifi-

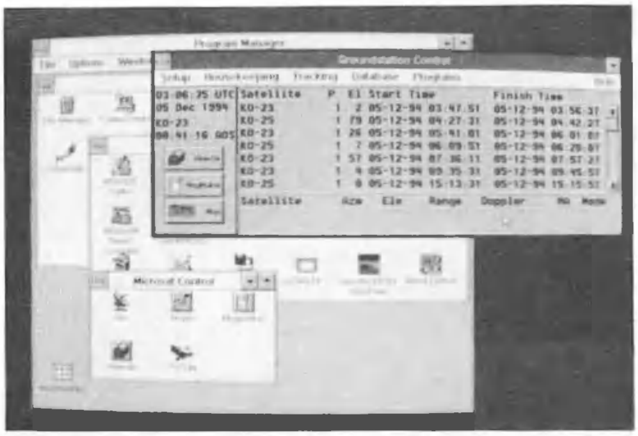


Photo A: Starting the Ground Station Control program in WiSP under Windows shows a schedule of upcoming satellite passes.

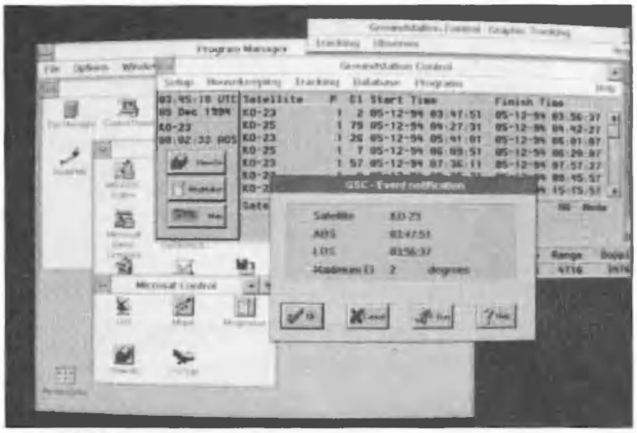


Photo B: WiSP announces a K-O-23 pass just prior to acquisition of signal (AOS).

Photo C: During a U-O-22 pass, files are captured and activity is monitored.

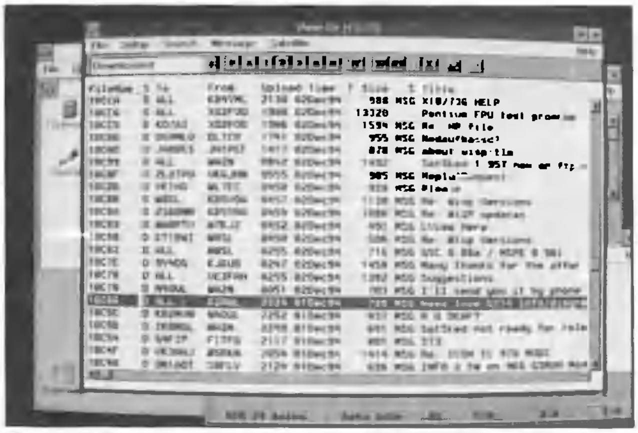


Photo D: Calling up View-Dir in WISP to check the files that have been downloaded.

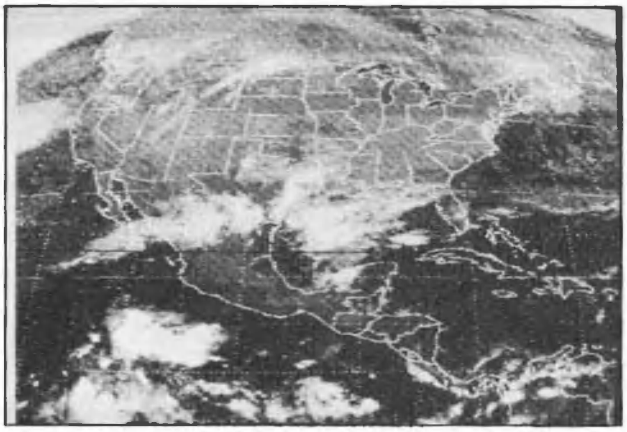


Photo E: A GOES-8 weather picture sent to K-O-25 from WB8LEM started as a 55K-byte .JPG file and expanded to a 448K-byte .GIF image

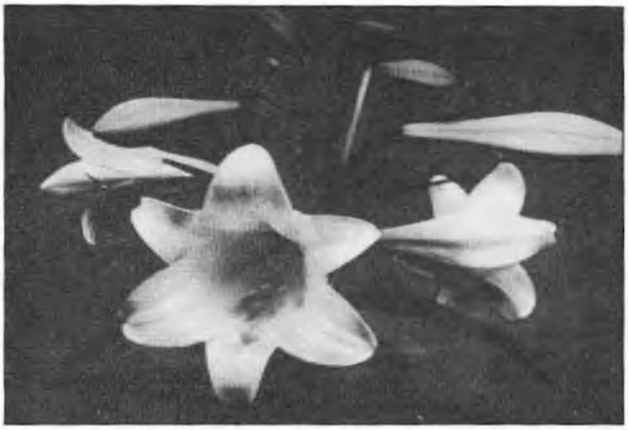


Photo F: This image of a flower from JA6VOY was uploaded as a 30K-byte .JPG file.

cations to attach the new unit. Most units are set for one or two speeds, but some incorporate digital-signal processing (DSP) chips that allow software changes to set speeds and signal types. A new modem from the Tucson Amateur Packet Radio Corporation (TAPR) is called the DSP-93. This kit costs just over $400, but shows great promise in preliminary on-the-air tests. It can run packet from 300 to 9600 baud and many other modes, depending on software availability. TAPR can be reached at 8987-309 E. Tanque Verde Rd. #337, Tucson AZ 85749-9399, and via phone at (817) 383-0000 or fax at (817) 566-2544.

The first software available for communicating with 9600 baud satellites came from the University of Surrey in England and was designed for use on IBM PCs and clones. A group of four programs allowed files to be modified and packaged for uplink to the satellite, sent to the satellite, received and then unpacked for use. The programs, PFHADD, PG, PB and PHS respectively, are still in common use today and do a great job.

PG is used to send files to the satellite and does not put the TNC in KISS mode. PB, the receive program, initializes KISS in the TNC and operates using broadcast protocol. All files and directory listings sent from the satellite are monitored and collected unless parameters are set by the user to block certain file types. Files of specific interest to the user can be tagged in the directory. The program will send a request to the satellite to download these tagged files or partial files. If the request is accepted the user will see his call in the queue of 20 downloaders. Popular files up to several kilobytes can be collected by a good system just by monitoring the downlink. Large files will require requests to be sent to the satellite to fill holes that need filling due to noise or signal dropouts.

One of the main complaints associated with the UoSAT programs was the lack of automation for file handling. To send a file to the satellite it must first be processed by PFHADD and after it is downloaded PHS must be used to unpack it. The file might have been compressed by PKZIP or LHARC, requiring further intervention. The solution was batch files to compose, compress and pack messages for uploading and post process files received during a pass. The downloaded files could be unpacked, decompressed and placed in specific subdirectories for messages, programs, images, etc.

Are You WISP'Ing Yet?

In early 1994 Chris Jackson ZL2TPO generated a set of programs for Microsoft Windows based on the wish lists of most 9600-baud satellite users. The shareware package was called WiSP for Windows Satellite Program. For computer users fluent with Windows, this group of programs is much easier to use for station control and file handling than the previous offerings.

In addition to doing all the things available with the UoSAT programs, the WiSP package includes satellite tracking software, drivers for rotator interfaces, event scheduling and message composition. Numerous help files are built in to allow the user to configure the program suite for individualized operation.

It is possible to set WiSP for completely automated operation. With the main program GSC (Ground Station Control) active, the system can launch programs to start uploads, download files, aim the antennas, control the radio frequencies, check for personal mail in the satellite directory, download any, set message priorities, unpack and sort downloaded files, and then close programs after the pass and go back to sleep until the next satellite comes by.

The capabilities are numerous. Buzz Gorsky WH6I wrote an article in the July/August issue of *The AMSAT Journal* describing he program functions and how to get initiated with the software. The help files don't provide enough details on program setup, but few "readme" files included in the package are enough to get a good Windows user started. Roy Welch WØSL, AMSATs Software Manager, is working on a more involved set of instructions based on the article by Buzz.

The complete package is available as shareware from the AMSAT ftp (file transfer protocol) site on the Internet. The address is ftp.amst.org. If this doesn't work, use the IP (Internet Protocol) address of 192.35.156.5. Answer the user name query with "anonymous" and password request with your Internet address. The WiSP programs are in the subdirectory amsat/software/windows/wisp. To register shareware the donation is $40 to AMSAT, 850 Sligo Ave., Suite

Photo G: A composite picture from OH2LU to VK3AHJ included a text message describing SSTV activity on HF

Photo H: OE3EV downloaded the original image from KB2MVN, added some pictures of his own and resent it via K-O-25 as a 98K-byte .GIF file.

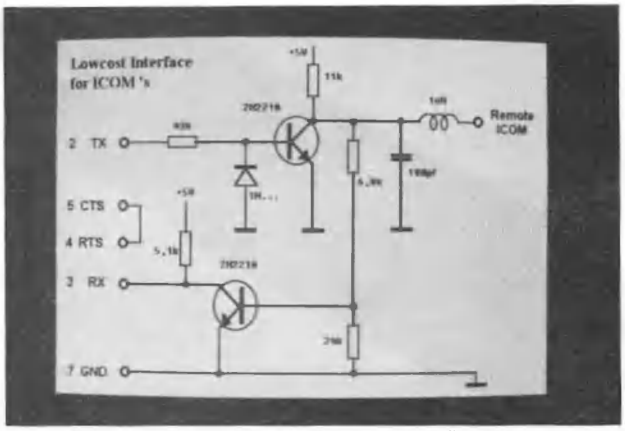


Photo I: Schematics in many forms are sent via satellite. This simple one was a 6K-byte .GIF file from OE3EV.

Photo J: EYE.GIF from VE3EGO started as a 41K-bye .JPG file sent via K-O-25.

600, Silver Spring, MD 20910, or via phone at (301) 589-6062. A special individual code will be given upon registration that will identify the software on the air as registered and remove the annoying message that appears when the program starts. To get the registered programs on disk the cost is $50. Donations are earmarked for the Phase 3D satellite program.

The WiSP package is continually changing. Since the *Journal* article, drivers for the Kansas City Tracker rotator interface have been added along with support for serial port line connections for control functions on most newer satellite rigs. Telemetry decoding has also been added. Updated versions of the programs are routinely uploaded to K-O-23, K-O-25 and the AMSAT ftp site.

Chris ZL2TPO is geting marned and moving to England and a new job at the University of Surrey. New versions of WiSP will come less often for a while. Perhaps is time for a new wish list. Wouldn't it be nice if the program could take freshly downloaded picture files, put them in little windows on the screen and then read any attached message files through the sound card? What else . . . hmmm.

Photo K: Gianluca IKØAIH sent this picture of the OASI Osservatiorio Antartico from his QTH at Terra Nova Bay on the Ross Sea in Antarctica via K-O-23.

Number 15 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV.
P.O. Box 1099
Falls Church VA 22041

Filter Design Software

A couple of years ago I purchased a printed circuit layout software package from a British company called Number One Systems, Ltd.

The advertising that was packed with the software listed several other packages, two of which were reviewed in this column previously (Z-match and Analyzer III). Recently I obtained a copy of another of the Number One Systems programs: Filtech. This program is designed to take the "black artness" out of designing filters.

Filtech will accommodate both passive and active filter designs, and schematics for each are given in the manual. A passive filter consists of only resistors, capacitors and inductors. An active filter includes some amplifying device such as a transistor or (more commonly today) an operational amplifier. With Filtech one need not resort to performing complex mathematics, or looking up "normalized" values in a table: The software does it for you. In addition, while the tables (as published in the *ARRL Handbook*) are relatively easy to use, they become a lot less convenient when comparing different filter designs. Also, the look-up tables don't take into consideration what happens when you use standard value, kind-you-can-actually-buy values rather than the computed values. Filtech solves these problems.

With Filtech you select a filter type (Bessel, Butterworth, Chebychev), or ask the program to recommend a type. You can set the ripple factor permitted (0.1 dB, 0.25 dB, etc), and set the frequency parameters. The program makes its calculations and displays the frequency response characteristic on the screen. It will also create a "net list" of preferred components.

Figure 1 shows the frequency response screen (and print-out) that Filtech provided for a 40 meter bandpass filter centered on 7.15 MHz. Overlayed are the ideal design passband and the passband of the version built with real components. Note that decibels (dB) of attenuation are along the vertical axis and frequency is along the horizontal axis. This particular filter was specified with 50 ohm input and output impedances (which is customary for RF filters). The net list of component values is shown in Figure 2. The component numbers refer to schematic values (see Filtech documentation for schematics). Passive filter responses for the audio range are shown in Figure 3 (low-pass) and Figure 4 (high-pass).

One aspect of Filtech that makes it quite a bit more useful and more powerful is that it interfaces seamlessly with Analyzer III (also by the same company), which is a network analysis package.

The only problem that I had is that it would not load on my computer. Filtech is an MS-DOS program, and some Windows machines (like mine) have too much stuff crudding up the lower 640K of memory that is used by MS-DOS. I dealt with the problem by creating a special CONFIG.SYS file for MS-DOS-only programs (see this column last month).

```
Number One Systems        FILTECH        Filter Design Synthesiser
            Date: 11.21.94          Time: 3:26 pm.
              Circuit: C:\FILTECH\FILTER.PRF

  Source Impedance  : 50.0 Ohms
  Load Impedance    : 50.0 Ohms
  Filter Model      : Passive Band Pass (N)

  Filter Design     : Chebyshev
  Maximum Ripple    : 0.1 dB
  Filter Order      : 3

Reference: R0          Component: R
  A=IN                     B=1
  R:47.0
Reference: C1          Component: C
  A=1                      B=2
  C:56.0pF
Reference: L1          Component: L
  A=2                      B=3
  L:11.0uH
Reference: C2          Component: C
  A=3                      B=COMMON
  C:4.7nF
Reference: L2          Component: L
  A=3                      B=COMMON
  L:120.0nH
Reference: C3          Component: C
  A=3                      B=4
  C:56.0pF
Reference: L3          Component: L
  A=4                      B=OUT
  L:11.0uH
Reference: R999            Component: R
  A=OUT                        B=COMMON
  R:47.0
```

Figure 2. Net list for the Figure 1 filter.

The company has offices in both Great Britain (UK) and the United States (USA). Address in UK: Number One Systems, Ltd., St. Ives, Huntingdon, Cambridgeshire PE17 4WR, England, telephone 011 44 1480 461778. Address in USA: Number One Systems, Ltd., 1795 Granger Avenue, Los Altos, CA 94024, telephone (415) 968-9306.

Contact the company for prices, or alternatively, check the Number One Systems ads in recent issues of this magazine.

In upcoming months we will take a look at the upgrade Easy-PC Professional XM by Number One Systems, and Electronic Workbench by Interactive.

Other Software . . .

A number of readers have commented positively on my Antlers for Windows 2.00 software. It is designed to calculate the lengths, spacings and so forth for a variety of antennas including dipoles and verticals of various types, beams (quads and yagis), and both large and small loop antennas. The price is $30. Contact me at P.O. Box 1099, Falls Church, VA 22041 if you're interested in Antlers for Windows 2.00.

Soap-Box Time . . .

Every time I go to the local ham radio stores I am disheartened by the lack of younger hams. As one of the graying heads of ham radio, I wonder how long the FCC is going to permit hams to use valuable spectrum space when the population of ops is both aging and reducing in numbers. The FCC is now of a mind to raise money by auctioning off frequencies, and ours look too plump to remain ours for long . . . especially if we don't use them.

We cannot always use the public emergency and public service excuses to hold onto our privileges. After

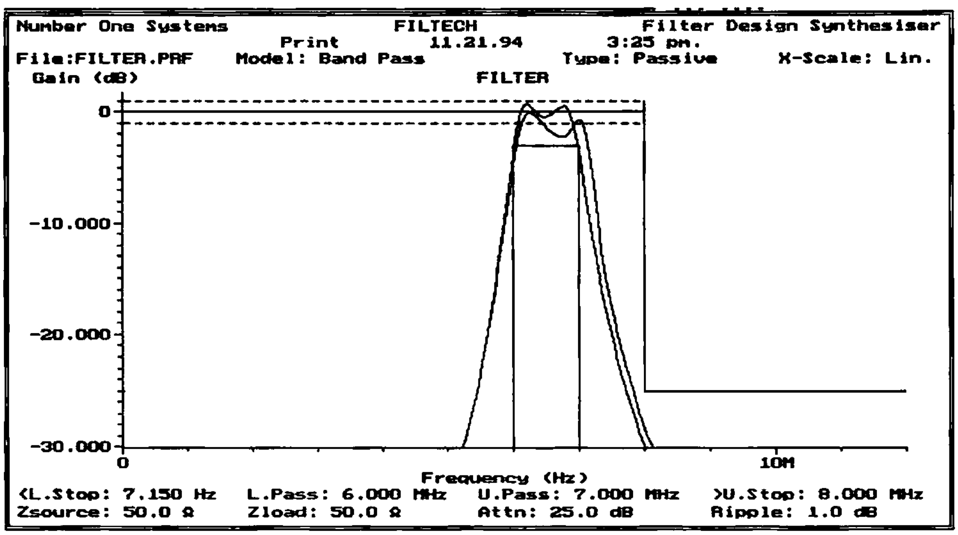


Figure 1. Bandpass filter response.

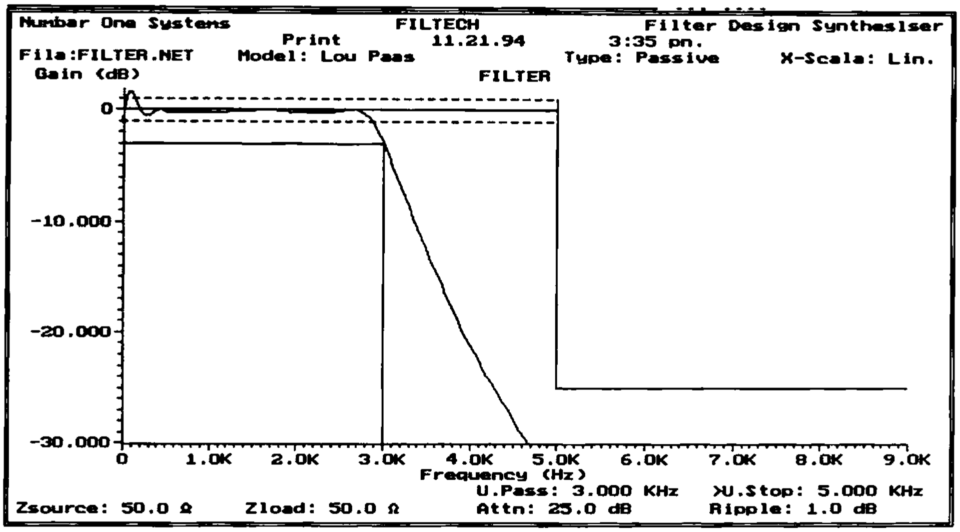


Figure 3. Low-pass audio filter response.

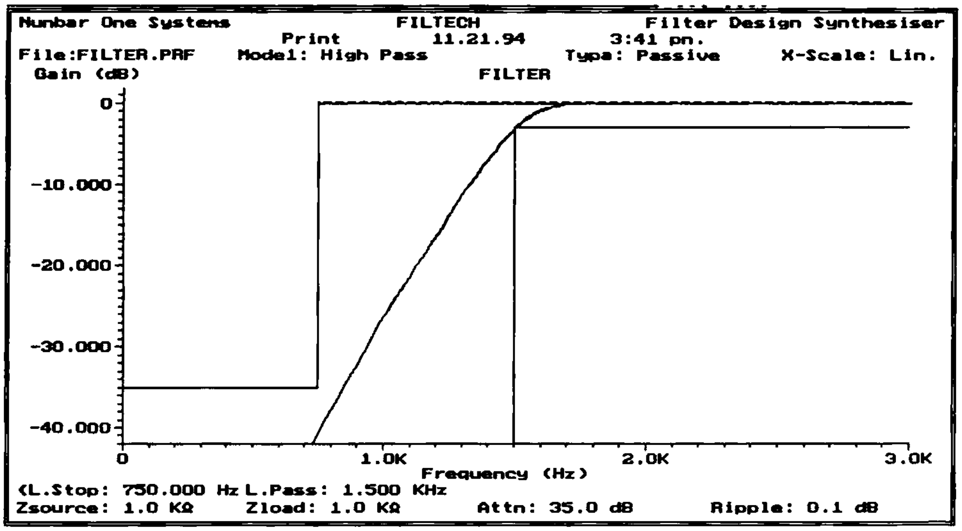


Figure 4. High-pass audio filter response.

all, cellular telephones can provide communications at sports car rallies, and a laptop computer connected to Internet through a cellular telephone can handle a lot of the health and welfare message traffic that we used to handle . . . without getting a ham license!

One way to build the numbers of licensed hams as well as increase the usage of our bands is to recruit new licensees. We will be a lot more challenging with higher numbers and an increasing population. My challenge to you (as in the past) is to replicate yourself: Actively mentor someone to get a ham license. Whether it is a kid down the block, or a colleague at work, or your spouse, it is worthwhile to proselytize for the hobby.

Look to both shortwave listeners/scanner buffs and to computerniks for new members. Also look to electronic hobbiests who are not hams. The ARRL is not taking the lead in this effort, even though they should. In a rather shabby *QST* review of one of my books (which drew comments from Harry Helms about the league's lack of integrity on book reviews) the reviewer made the incredible comment that suggested SWLs are ham wanna-bes. Wanna bet? There is a huge number of SWLs who are not striking for ham radio . . . and they are a prime source of recruits if we don't treat them with contempt.

Also, when I write an RF construction project for my column in another (general electronics) magazine, the number of letters I get are seven non-licensed (or at least no callsign in the letter or return address) to five licensed (callsign listed in letter or address). Why aren't we recruiting them? Perhaps they hear those incredibly rude bozos on 75 meters and 40 meters and prefer to shun us as impossible boors. We will have the ham radio future we deserve!

RTTY LOOP

Number 16 on your Feedback card

Amateur Radio Teletype

Mark I. Leavey, M.D. WA3AJR
6 Jenny Lane
Baltimore MD 21208

I'm sick. No, I mean that literally. I've had strep throat, been down for the weekend, and somehow managed to be at my daughter's birthday party, although I am not sure that I remember it all. I'll have to watch the videotape. Anyway, you might ask, what does that have to do with this column? Well, I don't know about you, but when I am feeling badly I often cuddle up with an old magazine or some neglected mail and see what's happening.

RF Problems

That is how I came across the Email received from Jack Phillips KD4VRD, JackKD4VRD@aol.com, who states that he is a new RTTY operator, having just gotten his PK-232 at the end of October. He has had a little trouble getting the tones to be clean, and wishes to share his trials and tribulations with all of us.

"I operated RTTY at first on my IC-737 with no problem. I then operated some VHF packet and went back to RTTY and the tones were garbled. I had moved the drive level on the TNC to work with packet and it was garbled on HF. I asked the ARRL Tech rep for our area, Gene Wood WA4PGI, for help and he put some bypass capacitors on the audio line and eventually put a resistor in the audio out lead on the HF rig. Works great now. I was getting a little RF into the shack. Some folks may forget about these simple fixes.

"I really enjoy RTTY. I got my license in 1992 as a no-code Tech, along with my wife, Pam. We both have upgraded to Advanced and anticipate Extra Class by Christmas. I have gone back to the last two years of *73* magazine issues and started reading your column over again. Lots of good information. Do you ever mention any RTTY nets in your column? I have checked into the Midwest RTTY net and found it quite helpful in learning RTTY and getting everything set up well. Even found a guy with my exact rig and TNC set up to bounce problems off. The MRN meets every night at 8:30 p.m. EST on 3.607 MHz plus/minus QRM."

Well, Jack, as you found out, simple problems often have simple solutions. And, most importantly, don't forget that this is, after all, RF we are playing with. In the old days an AM signal might be messed up by RF coming in on the mike line. These days, a little RF on the input can wreak havoc with communication.

New Net

A few years ago I tried to include a listing of RTTY and/or packet new frequencies. I have, to date, received very sparse information. So, I gladly pass along the information on the Midwest RTTY Net, and let that be a stimulus for other net operators to send me along the information on their groups.

Mac Software

Then there was the Email from Ralph Howard WD6BGN/CE8, who is aboard the good ship *Duke*, working in the Antarctic, who wonders about the availability of software for the Mac.

He writes, "I have played with RTTY since I had a Model 15 in the '70s. However, I haven't done much for the last few years. Packet just isn't a good substitute. Anyway, in the May issue you mentioned some fax software for the PC. Is there anything out there for the Mac? I have a Powerbook and, with the mike input, it should be a natural for RTTY, fax, CW, etc.

"With the concept of a 'software filler' no electronic interface is possible with the new Macs. Do you know if anyone has done it? I think I have seen some stuff for the SoundBlaster card for the PC. However I haven't seen anything for the MAC.

"I don't have a rig on board at this time, however I will be back aboard in January, and plan to bring my rig then. (Yaesu FT-80, KAM, etc.) So will be looking forward to talking to you on the green keys. (Uh, gray now I think, however these are sort of a dirty beige.)"

Well, Ralph, while I agree with you that the audio-equipped Mac should be an ideal RTTY machine, a scan of my local sources has failed to turn up any programs that meet this need. Or, at least I should say, failed to turn up any programs the descriptions of which allow me to know that they meet this need. Logging programs, communications programs for use with various interfaces, TNCs, or modems? Sure. But interfaceless RTTY programs? None found.

So, I await the proverbial flood of mail that will turn me on to the veritable plethora of software solutions that are out there, even as I pen (all right, type) this column. Stay tuned!

Other Requests for Help

Just to prove that *73* does get around, I received a letter from Sontaya Kumsan HS2KSP in Bangkok, Thailand. Sontaya writes that he is interested in RTTY and related modes, but that there is little local activity on the digital modes. He is looking for any help, locally or otherwise. A letter to 25 Moo 2, Hopukchaisavadisuk, Lad Krabang District, Bangkok, Thailand 10520, would certainly be appreciated.

I received a question on SuperMorse, version 4.15, mentioned here a few months back. One reader asks about the computer configuration required for this program. Well, it requires only 384K of memory, and supports a floppy disk or hard drive. The monitor may be monochrome or color; a standard mouse is also supported. Full use of SuperMorse features requires three serial ports, with a standard Sound Blaster configuration. Please note that while the program supports the Sound Blaster, it does not require this card. Of course, the program is easily obtained as one of the programs on Disk #7 of the "RTTY Loop" Software Series.

Of course, the overall interest in these now seven volumes of "RTTY Loop" software continues. The contents of many of the disks have been described in previous columns, but you can send a self-addressed, stamped envelope to me at the above address, or direct Email to me at CompuServe (75036,2501), Delphi (MarkWA3AJR), America Online (MarcWA3AJR), or via Internet (MarcWA3AJR@aol.com). As always, I look forward to your comments and questions, as well. Drop me a line and, who knows, you might just jog this brain of mine into action!

Number 18 on your Feedback card

HAMS WITH CLASS

Samantha Speirs, sixth grader, holds up a crystal radio from a project in a book from our Resource Center in the classroom.

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

New Resources

During the hot, sultry days of July last summer, I began my search for new and interesting books and resources to use with my ham radio classes. It's very important that we who are educators keep ourselves stimulated and always on the alert for innovative materials. A teacher or instructor must never become complacent about his or her subject area. Certainly, the teacher who uses amateur radio in the classroom has a plethora of materials at his disposal if only he will be creative in his approach.

There are many excellent commercially prepared books and curriculum packages for classroom use. I think it is incumbent upon those of us who are involved in teaching amateur radio to stay abreast of new technical books that come out each year. Two new books caught my eye this summer which I'll share with you.

Eyewitness Science-Electronics

The first book is *Eyewitness Science-Electronics* by Roger Bridgman, published by Dorling Kindersley of New York. The Eyewitness Science series is a highly informative series of books that traces the story of science from the ancient world to the present day. The *Electronics* book answers the questions, "What makes something electronic?" "How big was the first computer?" "How can a computer stop traffic?" "Why are microchips made out of silicon?"

Some of the really interesting chapters include: the preelectric world, electricity and magnetism, the importance of frequency, building circuits, communicating with electricity, development of the transistor, translating useful signals, analog and digital, signals and codes, integrated circuits, how electronic devices remember, microprocessors, and the future of electronics.

This beautifully-designed book will make a big hit with the children in your class. It is an excellent reference book with state-of-the-art photography. Superb full-color photography of original equipment, intricate scientific instruments, and 3-D models brings to life the ideas and discoveries that have influenced modern technology.

Connie Dunn KB5LES

My dear friend Connie Dunn KB5LES has come up with some very creative materials for introducing amateur radio to young children. When Connie goes into a school to demonstrate the fun of the radio, she takes puppets along with her. She brings Amanda Radio, who is an oversized replica of a hand-held. Sometimes she also brings Danielle, a very talkative and curious monkey. Amanda Radio actually tells the kids a story from a Big Book.

Connie has published a delightful reading and coloring book for young children called *Sam and Erin Go to a Hamfest.* The book includes a package of Crayolas and costs $5 plus $2.50 for postage. It can be ordered from Media Mentors, P.O. Box 131646, Staten Island, NY 10313-0006; Fax or phone (718) 983-1416.

Children are exposed to terminology used in amateur radio. They are taken through a hamfest where Erin finds out about flea markets, SAREX (Shuttle Amateur Radio Experiment), Elmers, ARES, Skywarn Spotters and callsigns. For teachers of lower grades, or those of you who can't wait to initiate your own youngsters or grandkids into the field, you'll be giving a wonderful gift with this book.

A major part of keeping children excited and eager to learn and participate in amateur radio is to provide resources and materials that are continuously updated and are challenging for them. I would feel as though I weren't doing my job properly if I didn't add at least two new items to my classroom reference section every year.

QRP

Number 19 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

The Xplor 32CA

I promised this month to have something rather different. I've got my linger deep inside the world of microprocessors. Yes, it is 1995 and there is more to QRP than NE602 mixers and 2N2222s. I don't know right offhand if I'll ever put this thing to use inside a QRP rig, bul oh, I do have lots of ideas!

The name of the project is the Xplor 32CA. It's a Personal Digital Controller (PDC) that provides a low-cost general-purpose programmable control device. It's primarily used in control applications of moderate complexity. The Xplor 32 may become the brain for hundreds of QRP projects. I know Bill Brown WB8ELK has used one of the Xplor's bigger brothers to measure and then transmit the air pressure in many of his high-altitude balloons. The Xplor 32 is available from Blue Earth Research. The basic unit goes for about $80.

The Xplor 32 operates from an 80C32 microprocessor. The BASIC language used in the Xplor 32 Is Tiny BASIC (TB52). This TB52 also has the ability to upload HEX files in an Intel compatible format. If you're up to it, you can also use assembly language to access the 80C32 µPC.

There is an 8K byte EEPROM that holds the resident program. An 11-channel, 10-bit A/D converter, and up to 24 digital I/O lines are possible. You can even use an adjustable wake-up timer for low-power applications. Also, depending on the selected unit, a built-in temperature sensor and humidity sensor are possible. Both sensors are available from Blue Earth Research.

Each of the 10-bit A/D converters has an input of 0 to 5 volts, with a resolution of about 5 millivolts. All of the A/D converters can be read directly from the Tiny BASIC. It's really simple to read any of the A/D converters. For example, 10 A=chan 0: print 0. This one line will print the value of A/D channel 0. The return will be a number from 0 (O volts) to 1090 (5 volts).

Talk To Me

The Xplor 32 communicates to the world via an on-board RS-232 port. A 9-pin DIN plug connects the Xplor 32 to any computer with an RS-232 port. In my case, I used a rather old Tandy 1100 FD laptop. This guy has no hard drive, so everything runs from one floppy. The software you can buy along with the Xplor 32 is very simple. It's really only a communications program. In fact, you can use the popular ProComm terminal program with the Xplor 32. Configure your communication software to 9600 baud, 8 bits, no parity, and one-stop bit.

What's slick about the Xplor 32 is its ability to operate *without* any terminal or computer being attached to the RS-232 port. You can power the Xplor 32 down, and then three hours (or three weeks) from now apply power and the program you uploaded will start working. The resident program will *always* be executed on power-up.

The Tiny BASIC does have limits. It does not support floating point numbers. Divide 10 by 3 and you get 3, not the 0.333333 you would normally see. The MOD command allows you to see the remainder from division.

Aside from the Tiny BASIC, you can CALL a number of assembly language programs. These are very useful when using an LCD display or a keypad. For example, a CALL 8132 will initialize the LCD display. CALLING 8134 will clear the LCD and place the cursor at the home location. A CALL 8140 will scan the keypad for a key press, and so on.

The Xplor 32 requires 6 to 9 volts DC. A wall wart-power supply Is all that is required to operate the PLC.

Putting the Xplor 32 to Work

I'll freely admit, I know just enough BASIC to do damage. I'm no Bill Gates. But even I've been able to do many things with the Xplor 32. Right now, my goal is to have a data collection for my solar array. Down the road, I will be using the Xplor 32 as a portable data collection device for solar arrays. In the sidebar, you'll see the code that writes four of the A/D converters to the LCD. It's nothing fancy, and in fact, this code took several phone calls to Blue Earth for some pointers. The support Blue Earth gives their customers is just great. I know, they were fighting over the phone for me. (It's your turn, I talked to him twice last time.) If you have an application that needs custom work, the staff at Blue Earth Research can more than likely help you out.

For me, the data collection on my solar array is working out just fine. I learn each time I key in something new. What can you do with an Xplor 32? Well, plenty; it's all up to you.

I see no reason why you could not use an Xplor 32 to monitor your antenna system SWR. By reading in the reflected power VSWR (you might need a op-amplifier to up the resulting value to something useful) and then do an IF statement on the reading from one of the A/D converters. It would look something like this:

```
10 A=chan 0
20 If A < 100 then bit 144=1
30 IF A > 250 then bit 144=0
40 GOTO 10
```

What I've done Is set the first A/D converter to a variable called RAS. Next, I told BASIC as long as A/D converter 0 is less than 100, make bit 144 a logical high. The next line tells basic if the A/D converter is over 250, then make bit 144 a logical low. Line 40 loops back and starts things all over again.

So, when the SWR is high on your antenna, the reflected power would produce a higher voltage from the RF sensor. This voltage, being monitored by A/D converter would keep port P.0.1 high until the SWR exceeded the A/D converter count of 250. At which time the port would go low. Now, you can do anything you want with the port, such at turn on a relay, sound an alarm, or whatever. As long as you operate the I/O port within its current and voltage rating.

Here's an ideal Since most of the rotor controls return a voltage determined by the position of the antenna, you could use the Xplor 32 to control your rotor. By keying in the desired degree, an I/O port would go high until the returned value from the rotor's pot equals the desired setting. All you would need to do Is read the keypad, one or two A/D converters and use the proper I/O lines to control the rotor. How about satellite tracking using two rotors? You have plenty of I/O lines and A/D converters to do it.

Will you be seeing an Xplor 32 in an upcoming QRP transceiver? That's hard to say. You just might. But, if nothing else, it's a great learning machine. I still know nothing about assembly but I can talk to my Xplor 32 in BASIC to begin making some interesting projects come to life.

Yes, there is more to QRP than just NE602s and transistors. If you ever get the chance to play with an Xplor 32, it's great fun! If nothing else, it will give you something interesting to talk about during your next QSO! You can always tell when I'm working on the Xplor 32 in my shack: There are the remains of several Oreo packages, as well as many dead Diet Coke cans, laying about.

Since my wife works some strange hours as a fish cutter (don't ask!) I usually have a Saturday night free to myself. When she leaves for work at 3 p.m. and then comes home at 2 a.m. she will say, "I see you have not moved all night. You still have your fingers in that thing?" Of course, I alway reply, "All the way up to my elbows!"

HOMING IN

Number 20 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Track It With Packet

In the heyday of spy movies and TV shows a couple of decades ago, the hero often had a sophisticated-looking device on the dash of his sports car. It received transmissions from a "bumper beeper" transmitter on the bad guy's car and displayed his exact location as they chased through the streets. The real radio direction finding (RDF) methods of the time didn't have enough accuracy to actually pinpoint cars this way, of course, but it made good fiction.

Tracking systems with this level of speed and accuracy became a reality in this decade, but they don't use traditional azimuth-triangulation RDF. For instance, the Teletrac Vehicle Monitoring System utilizes the difference in time arrival of the target's UHF pulsed transmissions at four or more receiving sites. For a complete description, see "Homing In" for July 1991.

In some other vehicle tracking schemes, the target determines its own coordinates using the Global Positioning System (GPS) and transmits them to the trackers. GPS technology is also at the heart of computerized navigation systems being developed for autos of the future. You may have had the chance to try one already—they are available on rental cars in some places to guide you in unfamiliar territory.

Wouldn't it be helpful (and lots of fun) to use this technology in ham radio? Imagine knowing the exact position and altitude of your club's ATV helium balloon packages throughout their flights, displayed on a computer map in every chase car along with the positions of each vehicle, as shown in Figure 1. If public service is your favorite activity, how about having instant updates on the locations of marathon runners, ambulances, and volunteer hams, mapped on the screen of your laptop computer, as in Figure 2.

Automatic Packet Reporting System (APRS), a shareware PC mapping and messaging program invented by Bob Bruninga WB4APR, has brought GPS and packet radio together to do all these things. "Homing In" for October 1994 and January 1995 introduced you to APRS, which some hams pronounce "A-pers." This month, we'll see how easily an APRS network fits into public service activities and look closely at the new Macintosh version of the program.

Where Is Everybody?

Most VHF packet stations use a "smart" device called a Terminal Node Controller (TNC). It ties the mike and speaker connections of the transceiver to the serial port of a computer. The TNC does the hard work of making packet connections, assembling/disassembling packets, and error-checking. The computer loafs, running a simple terminal program to display the TNC's ASCII output as letters and symbols on the screen, while passing keyboard input to the TNC.

APRS replaces the terminal program. It accepts your position data and other information as appropriate (course, speed, weather report, RDF bearing). It then encodes the data into APRS format and commands the TNC to beacon it to the packet network. Incoming packet position reports from other stations in the net are passed by the TNC to the computer, where APRS decodes the data and displays it on special APRS maps.

If you are stationary, all you have to do is type in your latitude/longitude coordinates to put your electronic pin on everyone's map. If you are moving, you can update your position automatically and continuously by hooking a GPS receiver's NMEA output to the second serial port of the APRS computer. Read last month's column for more on GPS receivers and their serial outputs.

Besides your own position, you can enter and transmit the positions of other "objects," as they are called in APRS-speak. Does this sound like an ideal way to use packet radio for public service race communications? APRS creator WB4APR thought so. In recent years, Bob and his friends have used his PC program in marathons, regattas, bicycle races, and even to track the ceremonial 128-mile game ball relay for the Army/Navy football game.

An unattended station does not have to have an APRS-running computer to be tracked by the net. For

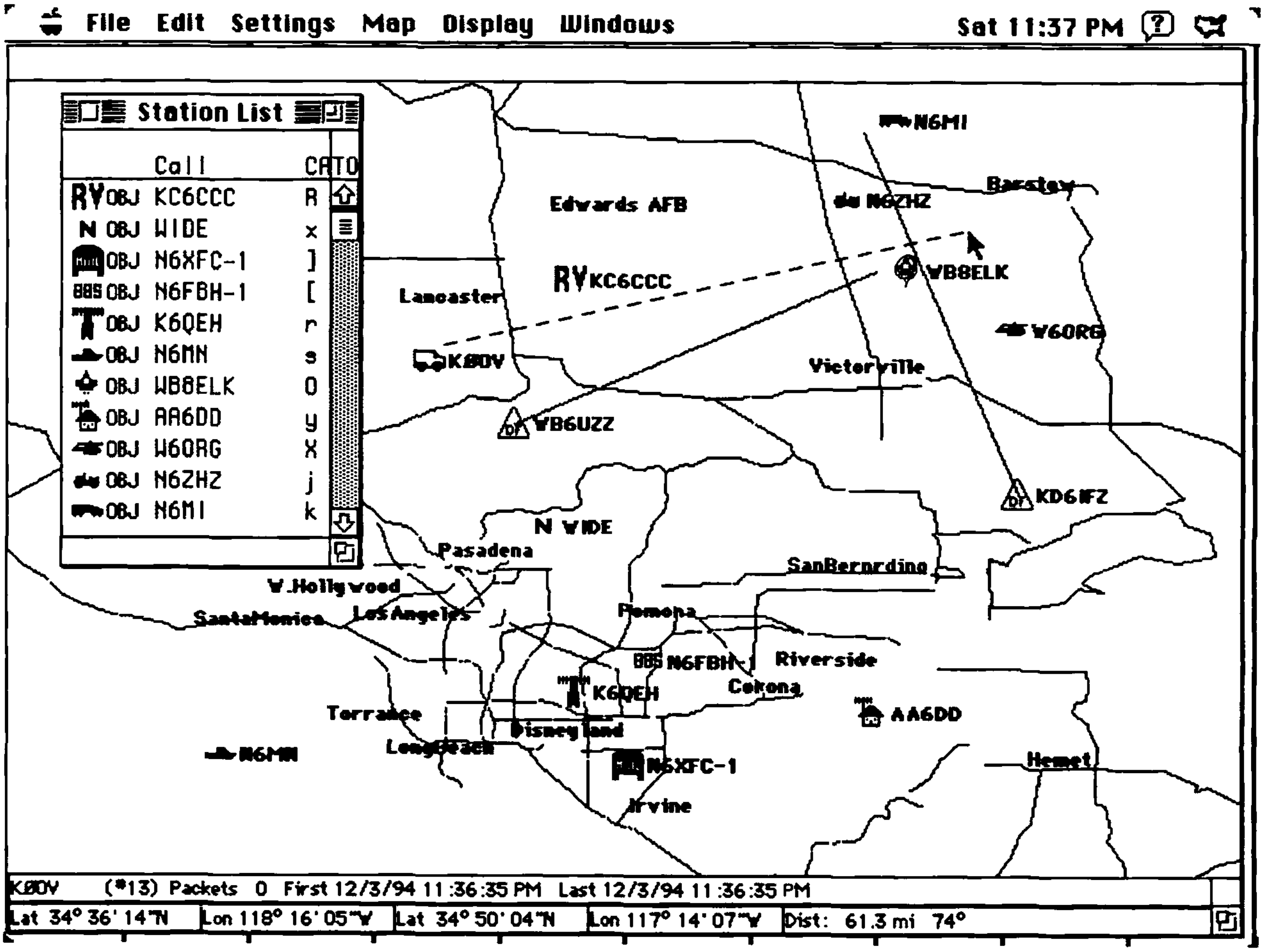


Figure 1. APRS maps RDF bearings, whether entered manually by mouse (the KØOV bearing) or automatically via packet (the WB6UZZ bearing). This is a PC-APRS color map by WB4APR in an 18K file, converted for MacAPRS. Some roads were in colors that did not print on the monochrome LaserWriter.

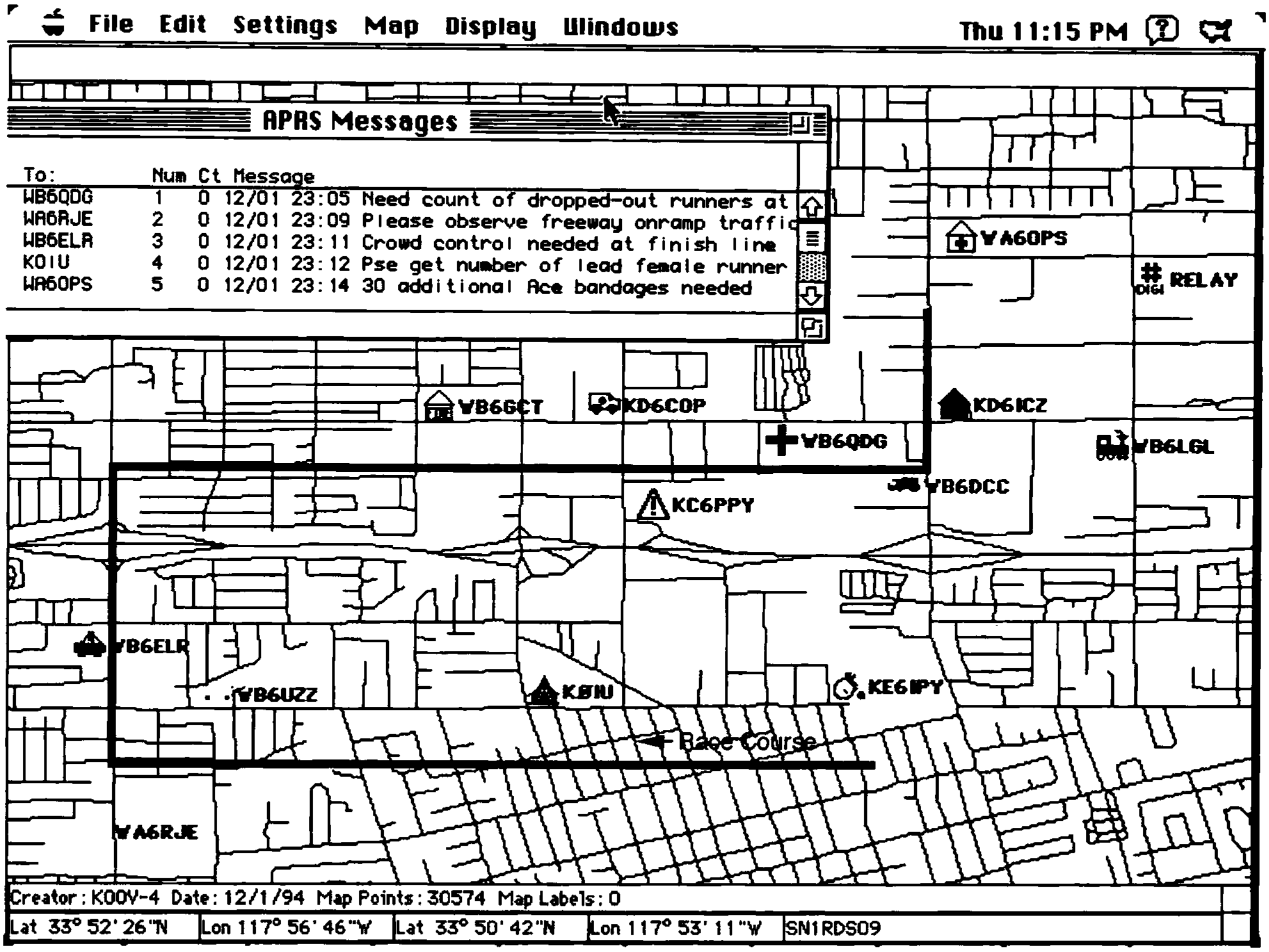


Figure 2. This race course is on a zoomed-in map made from 1:100,000 USGS CD-ROM data by WU2Z. The extra detail is not needed for a marathon, but it would be very helpful for transmitter hunting. The entire map is a 300K file that runs only on the Macintosh version of APRS.

public service, WB4APR lashes up "breadpan trackers" to put on vehicles. "Take an upside-down breadpan and put your TNC, radio, batteries, and GPS receiver into it," he says. "You can tape it to the roof of a car, or even put it on a bicycle. It's completely stand-alone, sending data but not receiving it."

WB4APR, who just completed his second year of communications for the Marine Marathon, continues, "On a voice net, we can hear where the lead runner is every few minutes, but hams tend to forget, or don't hear and have to keep asking. APRS is a tool to continuously display the first runner, sweep vehicle, and other important stations.

"Our marathon was on a bike trail that crossed roads only at major intersections. At each of those, there had to be a county policeman to stop traffic when the race came through. The police liked to be able to just look at a ham's laptop and see the little dot moving along. They then knew when to go out in the street and stop traffic."

Bob says you don't have to slow down a champion marathoner by putting a breadpan tracker on him or her. "We're not using GPS receivers on the runners or chase vehicles. It's a waste, because their movements are absolutely predictable. The voice chatter lets you know where the lead runner is and APRS fills in the gaps between voice reports.

"When the starting gun goes off, the command post operator tells the computer to put the lead runner object at the start line, sets it in the direction the course is going, and gives it a speed of nine knots. Every 10 minutes or so, he checks. When the dead reckoned spot doesn't make a turn, he hooks it, gives it a new direction, and it dead reckons along that way.

"It's darned accurate. Having done it several times, I know the right velocity to input for the lead runner. If I'm off by one MPH on estimating lead runner speed, it will only be 135 yards off after five minutes. GPS is usually accurate to within 100 yards, due to government-imposed 'selective availability.' So dead reckoning is almost as accurate.

"Instead of runners, we have learned to put GPS on things that have unpredictable routes. For example, 70 ambulances were at the race this year. They came from three states and many jurisdictions, so they had no common frequencies at all. The head Marine Corps doctor dispatched and communicated with the ambulances via amateur radio. The eight ambulances with GPS were the advanced life support units that could end up anywhere during the race. The rest were mostly stationary, so they didn't need GPS."

Good News for Mac Fans

Figure 2 is a mock-up showing the many possible objects that can be mapped on a race course. It also shows off the enhanced graphics capabilities of a new version of APRS for Macintosh computers. MacAPRS was written by Keith Sproul WU2Z, with help from his twin brother Mark KB2ICI.

Keith says he is hooked on Macs, and adds, "I'm a microcomputer manager for a large company. I'm responsible for about 600 Macs and 150 DOS machines. I have six Macs at home on an Ethernet with several gigabytes of hard drive space, two CD-ROM drives on my main machine on one on my ham radio machine, plus a CD-ROM drive on my server and a gigabyte on that. The ham callsign database is on my server and mounts on all the machines all the time."

Whereas WB4APR's APRS for PCs was created in QuickBasic, WU2Z wrote MacAPRS in Think-C. It has completely different code, but is intended to be fully compatible with all of WB4APR's APRS protocols.

MacAPRS takes advantage of the multiple windows, mouse, and pull-down menu environment of the Macintosh. Unlike PC-APRS, there is no map list file to keep updated. When you get a new map, just drag it into the map folder with the mouse. Selecting a map is as simple as pulling down a menu and finding it. With that map displayed, hold down the Option key and click-drag the map area of interest. The program will blow up that region to full window size. You can put aliases of zoomed maps on the map menu for future use.

When you click the mouse on any point on the map, the latitude and longitude of that point are immediately displayed at the bottom of the window. Pressing Command-E brings up a menu so you can put an object on the screen at that point (or you can type in coordinates of another point). This object may also be transmitted to the net.

MacAPRS has a library of about 50 object icons. They can be stationary, moving, (dead reckoned) or give other information such as weather data or

RDF bearings. Once an icon is on the map, you can move it by holding the Command key and dragging it to a new location with the mouse.

When you click and drag the mouse between two locations, a box below the map shows the coordinates of both points. It also shows the exact distance in miles between them and the azimuthal angle from start to finish. When I saw this feature, I realized that it would be a quick way to manually enter RDF bearings on the fly, without having to call up a menu and type them in. I suggested to Keith that he modify the program to add the ability to keep mouse-drawn bearing lines on the screen. "No problem," he said.

When a position report is received via packet, a symbol appears on the screen with a callsign next to it. Click on it and you will see the time it was heard, how many packets have been received from that station, plus the latitude, longitude and grid square in the bottom status line. If you double-click on it, you will get a window with a history file of every packet received from that station. If you have a commercial callsign CD-ROM on line, the program looks up the callsign and displays the data.

In addition to these windows, you can bring up others to show a list of all stations seen, a list of all messages seen, station information, and so forth. With another command, you can exchange one-line messages with any station via unconnected packets. Figure 2 includes a window of typical messages.

MacAPRS includes data bases for Zip codes and grid squares. If you don't know the exact coordinates of a home station, enter its grid square or Zip code and the program will display the approximate coordinates. MacAPRS utilizes existing and future PC-APRS color map files, once they have been converted to MacAPRS format by a program included in the menus. Maps created for MacAPRS only can be larger and more detailed, though, with about 20 times the number of points possible with PC-APRS maps.

If you have the USGS 1:2,000,000 scale map CD-ROM, you can create your own detailed MacAPRS map files. To limit file size and speed up loading, you can include just the features you want. If you don't need railroads or streams, for example, don't convert them.

More detailed 1:100,000 scale USGS maps are also available, showing individual streets. Keith says that in ZIP-compressed form, it takes 14 CDs to hold the entire US at this scale. He is not quite ready to release his program to convert these maps to MacAPRS format yet, but he says he can provide such maps of your town for a small charge. The map in Figure 2 was zoomed from a file made from 1:100,000 USGS data.

"I've had a lot of fun writing the program," Keith says. "I'm working hard to keep up with Bob's APRS improvements. There is a bunch of people running MacAPRS from Florida to Ohio to Texas. I regularly hear from a group in the Chicago area."

MacAPRS requires System 7 to run properly, and cannot be used on older 68000 machines. "It will not run on an SE or a Mac Plus," says WU2Z. "It will run on an LC with 6 megs of RAM, but it starts to lose out with anything smaller. To use the airport and Zip code data bases, you can run it with as much as 8 or 12 megs if you want, or you can selectively turn the data bases off and run with much less. If you have enough memory, you can have several maps open at once, plus the message and station list windows, and you can click rapidly back and forth. Stations in range appear on all maps simultaneously."

MacAPRS and its data bases require 3.3 megabytes in compressed form. If you have a fast modem, look for it on CompuServe and other services. Keith will provide the program on disks for $30 registration fee plus $10 for three HD floppies. "For those who have already registered the PC version with WB4APR and want mine too, the registration fee is only $20," says WU2Z.

Like Bob's program, Keith's is still a work in progress. As of this writing, the latest version (1.0.6) does not yet have all the features of the PC implementation. But once you have registered your first copy, the registration number you get will be usable with future versions.

APRS To The Edge Of Space

Keith is excited about applying APRS to high-altitude balloon experimentation. "A group of Chicago hams held a balloon launch in Minnesota on the weekend before Field Day," he says. "The package had a GPS/APRS beacon. I wrote some extra software for them so that the display would show the ground track of the balloon, plus the elevation at each point. The line on the screen map changes color with altitude. You can tell how the height varies as it moves around the countryside. In the future, their balloons will send temperature, barometric pressure, and humidity, if they can find inexpensive sensors."

Keith is giving high priority to implementing the RDF features of APRS into his Mac version. "I'm the Senior Technical Advisor to a college amateur radio club," he says. "I told them I don't want to do a balloon launch until they have at least two or three foxhunts under their belts. I won't put my thousand dollars worth of equipment up if there isn't a recovery system backup for the GPS telemetry. We need an RDF team that knows what to do."

If you live in the Midwest and would like to learn more about ballooning, GPS and APRS, plan to attend the 28th Mid-Winter Wheaton Hamfest on Sunday, January 29, at the Odeum Exposition Center in Villa Park, Illinois. You can see both versions of APRS and learn about it from WU2Z and from Ed Rogers N9LCI. The Near Space Science group is also holding a conference at the hamfest, including discussions of APRS for tracking high altitude amateur balloons. The 'fest starts at 8 a.m. and should end in time for you to watch the Super Bowl.

Correction

"Homing In" for December 1994 encouraged T-hunters to subscribe to Fox-List, an Internet reflector for RDF enthusiasts sponsored by the Boston Amateur Radio Club. The address for signups incorrectly included a hyphen. Here is the right way to subscribe: Send a one-line message to listserv@netcom.com with the text "subscribe fox-list" (without quotes).

APRS Authors

Bob Bruninga WB4APR
115 Old Farm Ct.
Glen Bumie, MD 21060

Keith Sproul WU2Z
698 Magnolia Rd.
North Brunswick, NJ 08902

Please include a self-addressed stamped envelope for replies when you write to software authors and *73* columnists.

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

GaAsFETs and the Radio Amateur: How to Re-Tune Circuitry for Amateur Use

Amplifiers can be constructed out of many different types of devices: from MMIC modular amplifiers, the sort that works in a drawer, from a plastic package, or from various discrete devices. Transistors or bipolar types are the most common devices available in both PNP and NPN varieties.

The transistor is a good device but has a couple of drawbacks when selected for the front end of a high-performance receiver. The primary reason to choose other devices is the noise figure.

The best noise figure is the lowest numerical value you can obtain; 0.76 dB would be a better (lower) value in comparison to 1.5 dB or some other higher numerical value. Best sensitivity is accomplished with the lowest noise figure. That's why a low noise figure front end for a receiver or converter is a sought-after feature.

Now enter the mitigating circumstances, namely frequency. At very low frequencies some bipolar transistors are very good in respect to the noise figure. The 2N3391 family of transistors performs quite well for audio and slightly higher frequencies. As we increase our frequency of operation to, say, 50 MHz, a multiwatt RF power transistor 2N3866 works well. This produced a noise figure of 1.3 dB in a 6 meter preamp I constructed many years ago. Sure, I could have selected other types of devices for this project, but at the time some 12 years ago alternate devices were expensive and static-destructible. I liked the durability of the power transistor and it has performed well to this day. It has even survived some relay switching failures on transmit. I put that device in the pipe wrench class of survivors.

As frequency is increased to around 1,000 MHz, transistors can work well, but the noise figure degrades to a higher value. Special transistor cases are needed to remove bulk capacitance and inductance in the transistor leads to allow effective operation at higher frequencies. The pill case with two emitter leads is a standard configuration. The dual emitter leads decrease lead inductance, making connections very short. This is extremely important at higher frequencies.

Early devices of this type were the MRF-901 and the NEC-021 transistors. Noise figures were in the 2.x dB range. If a better noise figure is desired, a different device would have to be used, namely a Field Effect Transistor (FET). Early FETs were obtained surplus from satellite systems at 4 GHz; they produced noise figures at 1 GHz, near or slightly below 1 dB at 1 GHz. As the frequency increased so did the FET's noise figure but it was several factors below that of a regular transistor. This was typical of the early Dexcel FETs.

Enter modem day FETs. They not only include very high performance (gain) but very low noise figures as well, up into the microwave region to 12 GHz. They are quite usable at lower frequencies and yield very impressive low noise figures at 144 MHz. The same device yielding a 3 dB noise figure and about 10 dB gain at microwave frequencies, produces noise figures of 1 dB or less and higher gains at 2 meters. At lower frequencies stability is a concern however, and precautions should be taken to ensure designs are well-shielded, preventing unwanted oscillations.

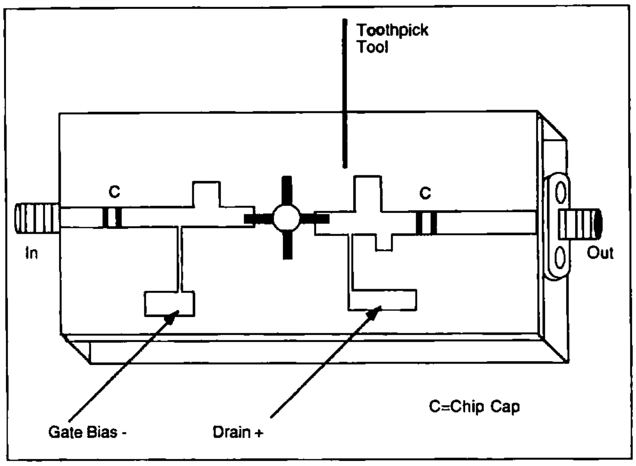


Figure 1. Sample FET amp stage tuning with "toothpick tool."

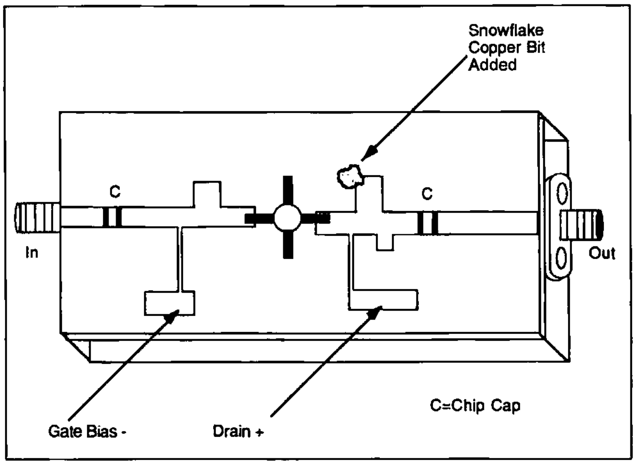


Figure 2. Placing "Snowflake" copper bits on stripline.

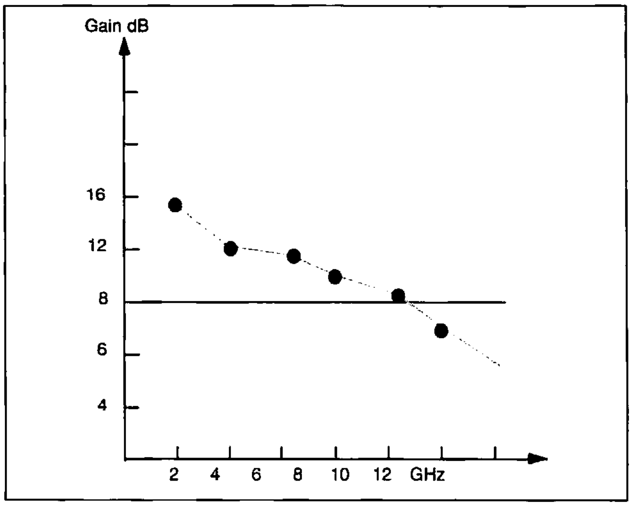


Figure 3. Typical "Gain vs. Frequency" chart for a GaAsFET.

FETs, specifically GaAsFETs, are capable of very high gains and low noise figures from a few hundred MHz to the very high GHz of the microwave region. Some of the newer Hempt GaAsFET devices produce some very good low noise figures and associated higher product costs. Two things seem to have prevented amateurs from using these devices: the cost of the device (which is decreasing as time progresses), and the device's susceptibility to destruction from static electric charges. Considering their cost, some of us do not want to play around with a $10 bill that could go "POOF" when handled improperly.

I avoided working with static-sensitive devices for those very reasons. I could not afford to make a "misteak" as my pocketbook would bleed heavily. Now, after working with expensive devices and even modifying circuitry from commercial applications to amateur frequencies, I have become much more tolerant and confident when working with GaAsFET static-sensitive devices.

There are some basic considerations for working with GaAsFETs in general, but the procedures are the same for all frequencies. From very low frequencies to 10 GHz and above these practices apply evenly. Use them; do not take shortcuts. Above all, think out the procedures described below and you should not have any trouble working with static-sensitive components. The following are some observations for working on circuits using GaAsFETs, made by my partner Kerry N6IZW. The job was to cover not just 10 GHz microstrip retuning but to make it applicable to other frequencies by component scaling. Remember: As frequency is lowered the circuitry becomes larger and easier to modify.

Microstrip Tuning Techniques

This is a description of the basic approach I have used to successfully retune many surplus amplifiers to amateur frequencies. These amplifiers were on frequencies in the commercial bands that would be unusable to amateurs in their original frequency configuration.

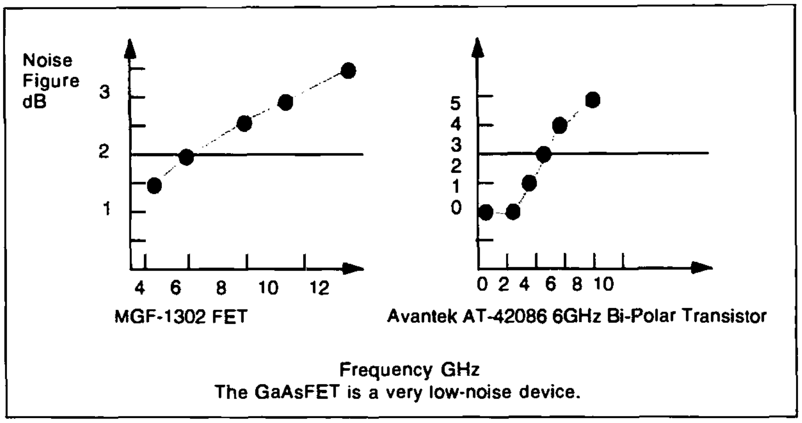


Figure 4. Noise figure comparison: bi-polar transistor vs. FET.

General Precautions

Everything must be grounded to power (earth) ground, including the soldering iron tip. The typical FETs in microwave amplifiers will self-destruct with more than 5 to 10 volts on the gate terminal.

Apply only as much input RF power initially as required to get a usable output measurement. This reduces the chance of damage to higher power devices prior to getting the output matched. Also, this prevents saturation of a stage which then appears to not respond to tuning. Applying more than about +10 dBm directly to small FETs may cause damage.

Use current-limited power supplies set to limit slightly above normal expected operating current. In most cases this will prevent blowing up the FETs if the negative gate bias is missing or something is accidentally shorted with the tuning wand. With this approach, sequencing of the power suppiles is usually not important.

Place attenuators directly at the input and output of the amplifier. This removes the effect of poor cable, source and power detector matching.

Always remove power when making connections and soldering tuning stubs. Make sure the amplifier output is terminated before applying power.

Tuning Procedures

Prepare the tuning wand and tuning stub material. Cut 1" or 2" strips about 0.080 wide (not critical), or about the same width as the main 50 ohm microstrip lines in the amplifier. Use thin copper or brass stock about 0.003" to 0.010" thick. Tin both sides of the strips and flick off excess solder. Make several wands by cutting one end of a wooden toothpick square at the largest diameter. Using SuperGlue, attach a square copper tab (0.080 by 0.080) of the prepared tinned copper or brass to the cut end of the toothpick. Wipe off excess glue from the exposed side of the square and let the SuperGlue dry.

Remove the existing tuning stubs. Using an X-acto knife, make a deep enough cut to disconnect the existing tuning stubs from the main 50 ohm line. Be careful not to cut the thin bias lines. If you are unsure of possible damage to the bias lines, carefully check continuity, or use a magnifier to do a visual inspection before applying power. In some cases it pays to go through the agony of removing the stub material completely as the correct new stub placement may overlap and cause problems.

Connect the amplifier to the signal source, power detector and power supplies. Turn on the power and adjust the input attenuation for as low an input as can be readily detected on output. Start at output and slide the tuning wand along (in contact with) the main 50 ohm line, watching for an increase in output. Note the maximum output reading obtained with the wand. Remove power and solder a square of the prepared material in the same position as noted by the wand. Do not add solder.

In some cases placing the wand near a certain area of the stripline circuitry decreases rather than increases the power. This is an indication that the existing stub or circuit stripline is excessive. Some of the material should be removed experimentally. Trim the existing stripline in small amounts, say widths about equal to an X-acto knife width. Do not make radical changes here; make small changes to determine the best results. If radical changes are made it may take radical tuning to restore operation.

The tinning is normally sufficient to allow the new tuning stub to be held in place with the pointed end of a toothpick and then just touched with the soldering iron to reflow the solder. Turn on the power and verify that the output is as high or higher than that obtained with the wand. Move the tuning stub if required to obtain results equal to or better than the wand. Slide the wand over the previously attached stub and if improvement can be made, attach another square. Continue this for the entire length of the main 50 ohm line until no further improvement is found. Increase the input power if working with a power amplifier and retune the output stage for maximum power output. BE CAREFUL HERE: DON'T MISMATCH THE OUTPUT SO BADLY WITH THE WAND THAT YOU DAMAGE THE FINAL POWER FET.

The process can be very slow, with some stubs only gaining a fraction of a dB. In most cases it will take all of those small increases to get good results so don't expect to see major improvements with a few stubs. It may take four stubs per stage to get maximum output. Above all, be patient with the circuitry and modifications; go slowly and don't rush any procedure.

Well, those are words to live by when working with GaAsFET devices and PC board circuitry. For me it was difficult to become proficient with these procedures as even with a good pair of reading glasses the circuitry at the 10 GHz microwave bands was not in sharp focus. To solve the problem I purchased a pair of magnifying glass attachments that are worn like a hatband affair, with the magnifying glasses swinging into place in front of the normal reading glasses. I was very impressed as now I could focus on very tiny postage-stamp-sized amplifiers and their circuitry was in excellent focus.

What I hope for in presenting this bit of advice is to promote more construction or circuit modification of existing devices from commercial surplus. As more and more of these devices hit the surplus markets they will find their way to the amateur for use at some band of interest. Whether it be for 432 MHz or 10 GHz operation, these newer FETs, static-sensitive as they are, can be handled without fear of destroying them. Once the devices are in a circuit they become much easier to handle and static-resistant.

In past columns I have provided information on converting 12 GHz LNBs, as well as 3.7 to 4.2 GHz LNAs and LNBs, to broadband operation by modifying the existing circuitry. The procedures described should give you a good handle on what to go through in the modification to mast any circuitry that uses GaAsFETs. We all make errors, but if you don't get in the thick of it and give it a try you will not be rewarded with success. I look at it now as spending a few disposable dollars on a circuit to modify and if it doesn't succeed I have gone to school on this item. It hasn't cost me an arm and a leg but only a few dollars, so no big deal. Start out with a small effort and then work up to larger and larger projects as you gain skills and success.

Good luck on your conversion/modification projects.

Update: LORAN Receivers

The LORAN receiver project was quite popular and our stock of good tested receivers became depleted. The receivers were a surplus item and availability was dependent on providence in the junk department. Well, I am happy to report that we have picked up a small quantity of the LORAN receivers again and have begun testing and the results look very good to a high yield of working boards. The unfortunate part of the story is that the price will have to be increased to cover our increased material costs. The new price for LORAN receiver boards as of 11/15/94 is $35 plus $3 postage, U.S. and Canadian destinations only.

Mailbox

James Duffer WD4AIR queried me on a parametric amplifier U.S. Army AM-6700/TSC. James reports that the name plate does not identify the manufacturer. The amplifier has a microwave waveguide flange input (appears to be 10 GHz) with a type "N" coaxial output. There are two other multi-pin jacks: one labeled "power" and the other "test." If anyone has information on this unit or suggestions for an application for using it contact James at 13203 Staggs Court, Woodbridge VA 22191.

Paul Baxter WA1WJB has picked up a CMC model 901 counter timer and a CMC-931 heterodyne Frequency Converter/Video Amplifier. He picked up both items for $10, although they had $75 price tags on them, at a surplus store that needed to make room for more interesting treasures. Paul is looking for anyone who has a manual for either unit. He has tried calling several of the larger surplus material houses but no luck so far. Can anyone give Paul a helping hand? Contact him at 3425 Terrazzo Trail, Virginia Beach, VA 23452.

Well, that's it for this month. Next month I will start a conversion project using a new surplus CATV front end tuner that we picked up recently. The things that make them attractive are the quantity available and their quality construction. They will serve many different future projects. The list of uses is just starting; for example, they could be used for a VHF spectrum analyzer, or parts of them could be used to form a 1200 MHz ATV receiver.

One feature of these CATV tuners is that they come with an internal frequency divide-by pre-scalar allowing you to determine the frequency of the local oscillator at a frequency divided down to 15 MHz of so. This feature makes many different frequency control functions possible. We'll start to cover some of these aspects on conversion and support circuitry next month.

As always, I will be glad to answer questions concerning this and other related topics. Please send an SASE for a prompt response. 73s Chuck WB6IGP.

Number 22 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Audio Stages

Last time, we were discussing the troubleshooting of audio amplifier problems in ham gear. Let's finish that up.

Please Be Discrete About This

If the amp is discrete (in other words, it has separate transistors instead of an IC), it usually will employ some form of feedback from the output stage back toward the input stage. The feedback network may go right to the input transistor, or it may be coupled to the stage after that. Either way, blown outputs can sometimes cause all kinds of damage, via the feedback nework, in the input stages. If the network consists of a series-connected resistor and capacitor, chances are the input stages won't get damaged, because the DC blocking action of the cap will prevent disastrous voltages or current flow from reaching the small-signal stages. But, if the network is parallel-coupled, and especially if it uses a low-value resistor, the input stage or stages might be zapped. And, of course, the network itself may become damaged, particularly if it employs an electrolytic or tantalum capacitor, which might then leak enough current to damage the input stages.

When changing output transistors, always be sure to carefully check any emitter resistors for cracks and opens. When the outputs short out, they try to pull full power supply current through those resistors, causing them to get mighty hot. Sometimes, tiny cracks in the resistors form and cause an open, stopping the current. Then, when the parts cool down again, there's enough physical contact for the resistors to sort of work again, I say "sort of" because the resistance value may go up and down, and the whole part may intermittently go open (arrrgh!!), both randomly and with temperature.

In high-power, hi-fidelity amps, many push-pull designs have biasing potentiometers, because it is important to set the bias very carefully for lowest distortion consistent with efficient operation. If the bias is set too high, the idle current goes way up, and the output transistor will run way too hot. If it's too low, though, crossover distortion increases to an unacceptable level. In smaller, lower-fi amps like you find in ham gear, nobody's worrying too much about crossover distortion, so the bias resistors are just about always fixed; you don't have to worry about that issue. But, there may be some diodes used to set the amount of current flowing through the bias network, so be sure to check them. After all, you often don't know what really blew the amp in the first place, and a serious increase in DC bias could have been the culprit.

. . . Kinda

So, you found some bad output transistors, or perhaps a blown audio amp IC, and you changed it. And, it works! Well, kinda. You have audio, but it's distorted or you can't get reasonable volume. Obviously, something else is still wrong. But what? Well, go back and check the squelch gate transistor, like we discussed last time. If there's plenty of power getting to the amp, try replacing the output capacitor, if there is one, paying careful attention to the cap's polarity. As a last resort, disconnect the audio line coming from the demodulator and try feeding it to another amp of some kind. If you don't have a small service amp on your bench, you can, in a pinch, feed the signal into the microphone input of a cassette recorder, as long as you use a resistor network first and cut the level down by about a factor of 100 or more. If the audio still sounds like it has the same problem as it does through the radio's amp, your trouble is somewhere else! All kinds of demodulator problems, including a mistuned discriminator coil, can cause audio distortion severe enough that it sounds like you have amp trouble. Heck, I remember one hamfest-special HT I worked on that always sounded distorted enough that it could have been off-frequency by 5 kHz. It drove me nuts until I discovered that someone had replaced the second local oscillator crystal with a 10.245 MHz rock, when the original had been at 10.240. So, it really *was* 5 kHz off, and the resulting distortion would have been very easy to have mistaken for an audio problem. It pays to do your sleuthing carefully, before you order parts or tear up the PC board.

The Other Side

At the other end of the audio chain is the microphone amplifier. Because the signals are so small, mike amps don't often blow up. But, other problems can arise. The most common in HF gear is RF feedback. The sound of RF getting into your mike circuit is distinctive enough that, once you've heard it, you probably will never forget it. But, different antenna, ground and microphone installations can produce variations on the theme that range from out-and-out squealing to bubbling noises to distortions which occur only on voice peaks. And, if you use any kind of speech processing, the mess gets magnified tremendously, thanks to the processors' compression effect. So, before you dig into a mike amp problem, it's worth seeing if the real culprit is RF feedback, which it often is. The easiest way to do that is to run the rig into a dummy load. If you don't have one, try turning the RF output power control way down. With the many rigs that don't have output controls for SSB, you just turn the mike gain control very low. And always be sure to turn off any speech processing. Of course, for any of these methods, you'll need to monitor the signal with a separate receiver, unless the rig has a built-in IF monitor function. If the garbage goes away, RF is causing the trouble. If it's still there, the mike amp circuitry may indeed be broken. To be sure, try operating on another band; a bad mike circuit will cause the same audio mess on any band, while a feedback problem usually changes from band to band. Also, try another microphone; old ones, especially of the crystal or ceramic variety, can go bad with age.

"I have seen a few cases where RF feedback was so strong that it actually damaged something in the mike amp circuit, but it's quite rare. It is possible to cause damage, though, by feeding very high audio levels, perhaps from another piece of gear, into the microphone input."

I have seen a few cases where RF feedback was so strong that it actually damaged something in the mike amp circuit, but it's quite rare. It is possible to cause damage, though, by feeding very high audio levels, perhaps from another piece of gear, into the microphone input. Whatever the reason, let's say you find that the mike circuit needs service. Now what?

Well, that depends on the kind of radio you're servicing. If it's a multimode, the mike circuit may include speech processing and vox circuitry. If it's an FM rig, some kind of automatic gain control (AGC) or volume limiting is probably included. And, of course, the destination of any microphone input circuit is a modulator; are you sure the real trouble isn't there?

Running Aground

When is a ground not a ground? When it's a mike ground! Many HF rigs use a separate ground for the microphone. Although it is ultimately connected to the other grounds, it comes directly from the microphone input on the mike amp board, and typically only the shield of the mike cable is connected to it. This arrangement goes a long way toward reducing RF feedback problems. Some mikes, though, don't have separate grounds, they tie the PTT ground and the mike shield ground together. That often spells feedback disaster. Before you go digging into the mike circuit, be sure your grounds are configured as specified in the manual. Not all mikes are ideal for all radios, and you may have to modify your mike to work with a separated-ground system. Also, some preamplified microphones are particularly susceptible to RF troubles, and nothing seems to clear them up except replacement with a non-preamped mike.

If you're sure you don't have a feedback problem, try turning your speech processor on and off. If the trouble comes and goes,the processor may be at fault. Then again, it may just be worsening some other bad stage's effects. Often, the gain increase that comes with processing can make everything, from feedback to bad circuits, seem much worse. I suspect many a fruitless hour has been spent poking around in perfectly good speech processors, when the real problem was nowhere near that circuit.

Mike circuits are best troubleshot with an oscilloscope. That way, you can see where the signal stops or becomes grossly distorted. If the signal looks good on the line going to the modulator, though, the mike circuit must be working properly. What about the modulator itself? If your rig has both SSB and FM, try transmitting on both modes, preferably into a dummy load. Unlike SSB and AM, FM uses an entirely separate modulator. So, if they both sound messed up, the trouble can't be in the modulator.

One common problem is overly bassy or tinny sound on one sideband. That is *not* an audio issue. It's caused by misalignment of the carrier frequencies, which determine the passband of the resulting RF after it passes through the sideband filter. When you change from one sideband to the other, the modulated double sideband signal appears inverted to the filter. In other words, the signals representing high and low voice frequencies switch sides within the filter's passband. No sideband filter is perfectly symmetrical, so it's pretty common for there to be some difference in audio frequency response between sidebands, but it shouldn't be much. When the carriers are off, though, part of the desired signal can get cut off, because it's outside the filter's passband, and some bass or treble voice frequencies get lost.

Well, I think we've about covered audio issues. Next time, something completely different! Until then, 73 de KB1UM.

NEVER SAY DIE

Continued from page 4

14,313, and on a few chosen repeaters. This Is a hobby! It's supposed to be fun! We have a ton of fun things you can do, so the next time I give a talk, I want to see some damned hands go up when I ask if you've been active on our satellites, or been on a DXpedition somewhere. I want to see hands for RTTY, even more packet hands, slow-scan, 6 meters, aurora DXing . . . . and elmering. I want to see those hands waving when I ask il you've given a talk at your local school on the fun of amateur radio.

If you've got a computer why aren't you helping your club have a better-looking newsletter? Some are wonderful, but others are real crud. Tsk. All it takes is a Mac with Word, a laser printer, and you're in business. The next step is to find out il anyone in the club is doing anything interesting and if so, write about it. Someone must be involved with something more than saying nothing at length over the repeater.

Now where did I put that REPENT! sign?

Oh yes, if you have any friends who are building interesting things or inventing new antennas, the chances are they aren't writers, so write about what they've done and give me a chance to publish it in *73* or *Radio Fun.*

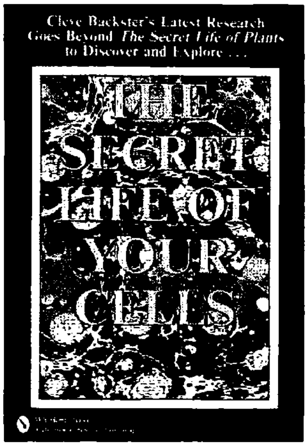
Commercial Break

If you have any friends who are interested in making a recording in a studio designed specially for digital recording, I can show them some fan letters from people who've heard our incredible Scott Kirby CDs. These were recorded at the studio at my farm in Hancock, and there's nothing else like it, as far as I know.

And, if you run out of things to talk about on the air, you could do worse than send $20 (postpaid) for my 360-page book and 320-pages of *Updates* (while they last). They're packed with practical proposals for solving our more serious social problems. Like crime, drugs, crowded prisons, welfare, the deficit, foreign aid, health care, our terrible educational system . . . stuff like that.

If you think it costs a bundle to go on a DXpedition you need to invest a measily $7.50 for 96 pages of *Uncle Wayne's Caribbean Adventures,* where I visit hams, DX, and scuba dive my way through the islands. Or perhaps you'll benefit from seeing how Uncle Wayne deals with Russia, the Crimea, St. Pierre, Krakow, Vienna, Prague, Munich, Aspen and London? $5 for 52 pages.

Then there's *Uncle Wayne's WWII Submarine Adventures.* Five war patrols, 60 pages for $7.50. The prices are all postpaid. For anything else from Uncle Wayne, like books and



code tapes, there's a $4 packing and shipping fee per order. That's where we make all our money.

If I can get some help running the magazines I'll finish editing the story of my African hunting safari, complete with visits to hams all around the world . . . Italy, Greece, Kenya, Uganda, Tanzania, Sudan, Ethiopia, Eritrea, Egypt, Lebanon, Syria, Iraq, Iran, Afghanistan, India, Nepal, Burma, Thailand, Singapore, Australia, New Zealand, New Caledonia, Fiji, Western Samoa, American Samoa, and Tahiti.

Well, you see, Robbie 5Z4ERR kept pushing me to come over and visit him in Nairobi. So while I'm there, why not do some hunting, right? I found a book by Herter on how to go on an African hunting safari for $690. That clinched It. Two other hams I talked Into it through my editorials and I really did go on a $690 safari and I shot all kinds of game, including a near record water buffalo, eland, oryx, and so on. It's a heck of a story . . . especially when we came that close to getting killed by some Somali tribesmen in the Rift Valley desert of northern Kenya up by Ndoldol.

Another Great Book!

In between reading books on quantum mechanics, I've also been sneaking in some books on biocommunications. I've already recommended the wonderful book, *The Secret Life of Plants,* and the second book reporting on Cleve Backster's work, *The Secret Life of Your Cells.* In those I learned about the research that's been done showing how people and plants can communicate and how your cells stay in communication with each other, even when separated by thousands of miles from you.

Now I've come across an incredible book by J. Allen Boone, *Kinship With All Life.* Here I found out that people can communicate, mind-to-mind, with animals, reptiles, and even insects such as ants and flies. This ties in with many other books I've read about people who have been able to talk with animals, but never before have I found

a how-to-do-it manual.

At first I thought that this book would be particularly difficult lor skeptics to deal with. Then I realized that this isn't a problem at all . . . because they would never even bother to read it. That's the best way to maintain a skeptical ignorance.

Kinship was published by Harper San Francisco, $9, 157 pages, 1976. ISBN 0-6-060912-5. Get a copy and read about Freddie the Ity and Strongheart, the actor-dog. I'll get you to thinking about the difference between life and inanimate matter yet.

There was an interesting article in the July 1994 *Scientific American* on consciousness. I was glad to see that I'm not the only one concerned with trying to understand what life is. In the article Colin McGinn argues that the relation between mind and matter, consciousness, will remain forever beyond human understanding . . . just as rats or monkeys will never understand quantum mechanics. So far the lack of understanding seems more due to a lack of research than an ability to understand.

It's Always Something

Yes, of course I'm spread too thin. Just running *73* is more than enough for one person to manage. Heck, I did it full-time for years. Real full-time . . . . like 100-hour weeks. And that was with a staff of eight to a dozen people handling the ad sales, editing articles, doing the typesetting, proofing, artwork, page layout and paste-up, subscription efforts, newsstand sales, bulk sales to ham stores, bookkeeping, dealing with columnists, testing new equipment, running booths at hamfests, customer service, dealing with the post office, and so on. I even used to have some time to get on the air.

With *Radio Fun* it's the same thing, although there is a good deal of overlap, with the *73* team doing much of the work.

But then my publishing *CD Review* got me involved in the music business. Very involved. Having been a music lover from my early teens, and into hi-fi manufacturing 40 years ago, it seemed to me that a magazine devoted to promoting compact discs might help this amazing new digital format be accepted. It did, and the magazine quickly became the leading music review publication in the country.

That got me into starting my own record label so I could record the incredible ragtime performer, Scott Kirby. I think that's helped too. When I started doing that there was only one ragtime festival in the country, in Sedalia, Missouri. Now there are over 20, and they're spreading to Europe with ragtime festivals in France and Hungary. And Scott Kirby, who has brought a whole new meaning to ragtime, is the featured performer at most of these!

In order to make better recordings of Scott I built a state-of-the-art recording studio. That's fine, except that once I did that I had to advertise it, get

a sales person to make calls and send out literature, have an engineer, book in acts, and so on. That takes a staff.

Making the CDs requires writing the liner notes, taking the cover photos, setting the type, doing the layouts, printing them and the tray cards, doing the artwork for the disc, mastering the studio digital audio tape (DAT) recording, and then having the CDs pressed, put in jewel boxes with the liner notes and tray card, and shrink wrapped. The cassettes have to have J-cards designed and printed, and the cassettes duplicated and shrink-wrapped.

It's useless to just make CDs and cassettes if you don't sell them. That means ads in magazines, promotion to newspapers, magazines, and radio stations, a sales staff, a warehouse for inventory, packing/shipping personnel, and a couple of bookkeepers. More staff to hire and manage.

Since most CDs are sold through record stores I needed a way to reach them. I found there was no publication aimed at the 10,000 record stores, so I started *Music Retailing* as a way to get the word out about my CD releases, plus any other record companies I could get to advertise. We also ran ads from accessory companies, store fixtures, sales systems, security systems, and so on.

The more CDs you have made, the lower the price, like anything else. So I started soliciting manufacturing orders from other small record companies to build up our volume. That meant more ads, sales literature (which had to be written and printed), a sales staff, and more staff to do the liner notes and tray cards, to help with the jewel box stuffing and shrink wrapping, and so on. More staff, more problems, more bookkeeping, more legal work dealing with the music copyrights. One song that a customer lied about on our copyright release form cost us nearly $40,000 in legal fees! And soon we were manufacturing CDs for over a thousand small independent record companies, with each CD having 10-20 songs. What a legal nightmare!

To help these independent record companies sell their music I started a CD sampler program. The one thing that sells music best is hearing it. Unfortunately, the indies are unable to get much radio airplay. The six major record companies (five of which are foreign-owned), pay nearly a hundred million dollars a year to make darned sure radio station music directors play only their music. So I started putting together sampler CDs, each with around 15 tracks of one type of music, as a way to help indie sales. We've produced over 125 of these so far and distributed from five to 15 thousand of each free . . . except for a $3.79 shipping and handling charge.

We paid for the manufacturing of the samplers by selling the sampled indie CDs by mail order. When they are manufactured the factories always make a lew extra. We made a deal to keep these and sell them to pay for putting one of their tracks on a sampler.

Our efforts seem to be paying off because the market share for independent music has gone from 4% to 15% in the last five years. That's over a billion dollars more in added sales.

To help bring in more manufacturing contracts I started sending a monthly publication to about 15,000 independent labels . . . *The IMPS Journal.*

This kept more people busy editing, selling the ads, doing the typesetting and proofing, handing the circulation, bookkeeping, and so on.

In all I had a complex of intertwined divisions geared to produce ham magazines and sell independent music. The only possible way for me to cope with two ham magazines, Uncle Wayne's Bookshelf, the music publications, a mail order music company, a recording studio, a record company, a CD brokering business, distributing indie CDs to record stores, the sampler CDs, my "Speak N'hamsha" tape, a videotape on sales promotion, marketing my *Declare War* book, and so on, was to have an administrative staff and depend on them. Any one project I could handle, sure, but over a dozen of them?

So I had a financial officer to handle both the company and my personal financials. A general manager kept track of the division managers. All I had to do was attend weekly management meetings to see how things were going and look over the financial reports. When any problems came up I'd see what I could do to help.

Most of my time was taken up with giving talks at music conferences and hamfests, working with the New Hampshire Economic Development Commission, writing lengthy reports to the Commission, working on the local hospital board, and taking off now and then on combined ham radio DXing and scuba diving trips. My homework for the Commission involved subcommittee meetings several times a week, an hour's drive away in Concord, plus reading over 200 books. So I managed to keep fairly busy. Oh yes, I also wrote my usual short editorials for five publications a month.

Oops, make that six editorials. I almost forgot about *"Cold Fusion."* I took off a few days last December to attend a cold fusion conference on Maui. Last spring I staffed and started the magazine. Then last summer I found tha the company financial situation was a mess. I discovered we'd been getting fudged financials at our meetings and that we owed the IRS a bundle.

Having had a disastrous hassle with the IRS some 20 years ago, even though I'd done nothing wrong, I was incredibly sensitive on the subject, so I almost got upset when I found out what was going on. I was even further edged toward being upset when I found that all of my personal stocks had been sold, my bank accounts emptied, and my credit cards were at their limits.

It turned out that there was a plan to put Wayne out of business, with one group taking over the music publications, another the CD manufacturing, one the ham magazines, and the fourth wanted the cold fusion magazine.

When I discovered all this I cleaned out over a dozen people and took over myself as chief financial officer, general manager, and the editor of *73, Radio Fun* and *"Cold Fusion."* I put the music publications on hold and cut the cold fusion magazine back in pages so it would be in the black. The glossy magazine was costing us around $50,000 a month more than a simpler publication with me as the editor, so that had to be changed. I hated to do it, particularly when I learned that our third issue had won the coveted *Folio* Ozzie award for the best designed new technical magazine of 1994 and that we'd been getting a record 76% newsstand sale (40% is considered outstanding). And this despite a $10 cover price, which some worry-warts said would keep it from selling.

The September issue was the first in the new format, and it was very well received by the subscribers. Only two refunds were requested, and there were lots of letters saying how good the new publication looked and how full of information it was.

I won't cry on your shoulder about the missing articles the ex-editor took with him, the stolen mailing lists, and things like that. But it was a mess and the three teams of lawyers involved will end up doing very well by the time all this is over. We're still trying to find where a couple of million dollars went.

So how are things going? Amazingly well, considering. The back IRS bill has been paid, and the penalties and interest will be paid off in a few weeks. The ham magazines, Uncle Wayne's Bookshelf, *"Cold Fusion,"* and the CD manufacturing operations are operating in the black, and we're paying off our debts as fast as we can.

What really hurt was when a pinko ham newsletter interviewed some ex-employes who were at the root of our troubles and printed their lies. Several advertisers, on the basis of these lies, cancelled their ads, which could cost us thousands of dollars. And who

knows how many hams might decide not to subscribe as a result? One ham news reporter said the word going around was that there was a plot between one of my employees and a certain ham publisher to have the IRS put us out of business and then grab *73* for a song when the IRS auctioned it off.

I can run the business just fine when I have to, but I prefer to develop magazines to help new technologies grow, to tackle our major social problems, and have a little time for hamming, skiing and scuba diving. Heck, I've worked hard for a lifetime and in my 73rd year maybe deserve a little slack.

Of course probably my biggest problem is that I've never had any interest in making money, so when I've lucked into it I've always let other people take care of it. Managing money is a full-time job, and it's not my idea of fun. I'm getting my Social Security checks now, and that's more than enough for what I need personally.

I'm working to build the *73* and *"Cold Fusion"* circulations. No one who's keeping up with the research in the field doubts that we'll have cold fusion powered homes and cars in just a few years. And probably watches, airliners, and everything else. I expect watches and small communicators will be powered by cold fusion cells made up of a few molecules thick alternating layers of titanium and deuterium. They'll run forever. Well, we'll see.

The coup at *73* failed, the bad guys are out, and we're a smaller, fighting team. We're making money and paying our back bills. I hope my friends will help me by getting more subscribers, and maybe even lean on some of the advertisers to come into our magazines, or increase their ads.

By the way, the same prize-winning production person who won the Ozzie for *"Cold Fusion"* does *73!* That's Linda Drew, who's been with me for 16 years now and works magic with our Macintosh publishing system.

Another little project that's taken a good deal of my time has been promoting the AIDS cure which was discovered by the Albert Einstein College of Medicine (they even have a patent on the process). This approach sounded logical to me and didn't seem to have any potential for doing damage, so I put together an instruction pamphlet on how to build the very simple device involved. I've sent the pamphlet free to anyone who asked, guaranteeing nothing. It's an experimental approach which doctors should be testing.

Since then many people have rid themselves of AIDS using this device. Amazingly enough, I haven't heard of any failures! The unit also seems to wipe our hepatitis and herpes viruses. But most astounding of all, a good friend who had no HIV or AIDS tested the device on himself, zapping his legs for a couple hours instead of a few minutes, just to make sure no harm could come from the procedure. What happened was that this apparently wiped out a lifetime of accumulated parasites in his blood and reset his appestat, with the result that he started losing weight . . . even though he continued to eat normally. He's lost 65# so far, and his wife, who knew a good thing when she saw it, quickly went from a plump 145# to a thin 120#, where she hadn't been since she was 17. This sounds like great way to get back to one's normal weight. When I think of how hard I had to diet to take off 100 pounds!

OK, I'm exaggerating. Sort of. I dieted for about seven months 20 years ago and took off 85#. And kept it off! Recently I decided to drop another 15#, and I've done it. But that's meant doing without ice cream, bialys and other goodies. I'll have to give the zapper a try and see if I can lose some more and still be able to eat ice cream and bialys whenever I want.

Let's see now, how many millions does it cost to get FDA approval on something like this? And how many years does it take? Ugh. I doubt I'll live that long.

"The coup at 73 failed, the bad guys are out, and we're a smaller, fighting team."

What's a bialy? Tsk. Bialys, short for bialystokers (named after a city in Poland), are a kind of bagel. They are terribly addictive, so don't try even one. You slice them in half the long way and give 'em a 20-second zap in the microwave to return them like fresh out of the oven condition, a little dab of butter, and mmmm. Wow, are they good! One of the local supermarket chains (Shaws) brings 'em in frozen and sells 'em, but very few people have discovered how good they are. They're made with a high gluten flour, so they're chewy, and they're sprinkled with onion.

They're also fabulous toasted, and you can keep 'em in the freezer. About 30 seconds in the microwave thaws 'em out so you can cut 'em in half.

There are a lot of things I should be doing, if I had the time. Like making up ads to help sell our crummy warehouse full of CDs. Like promoting my *Declare War* book. Like promoting our "Speak N'hamsha" tape to the New Hampshire gift shops. It's a wonderfully funny tape narrated by Fritz Wetherbee. This tape helped Fritz become a fixture on Channel 11 with his New Hampshire Crossroads program.

Most of all I'd like to try doing a daily talk radio program and syndicating it. I'd like to help people discover some wonderful music they've probably missed, books, poetry, cooking, get 'em hooked on amateur radio, and so on. I'd also like to get 'em interested in actively changing welfare, our prison system, and a few other critical social changes that are needed.

None of the mess has affected *73* very much, but *Radio Fun* came close to being put out of business. They got it way behind schedule, angering the readers and annoying the advertisers. By the time you read this it should be back on schedule, doing its job of providing inspiration to every newcomer to the hobby, encouraging them to try the many wonderful aspects of hamming.

Say, you could do worse than enter a $25 combo subscription for *73* and *Radio Fun* for your local library, and for your nearby school libraries. If the kids aren't able to read about hamming, it's going to be tough to get 'em interested. And without a raft of new blood coming into the hobby, we could easily lose the whole works.

The main purpose of *Radio Fun* is to help hams get involved with more than rag-chewing . . . to get 'em started on packet, satellites, and so on. It even pushes the fun of CW . . . which can be a ball, once the code comes easily . . . and all that takes is a few hours of practice with computer generated code, or with good ol' Uncle Wayne's Bookshelf code tapes.

Your Property Confiscated!

What would be your reaction if your state government were to decide to take your house and property from you with no compensation and then agree to let you keep using it only if you paid them rent? And if you have a business, they'd also take your building and land, still with no compensation, and let you keep using it only if you paid rent?

Think about it. Would that be enough to make you mad? Would it be enough to get you to want to actually do something to fight back?

Well, if you think about it, that's exactly the situation if your state has a property tax. The fact is that you don't really own your property. If you fail to pay the rent (tax), the state will take it away from you and auction it off to pay your unpaid rent. The purchaser won't actually own it either, just being the new renter.

Solutions Wanted

An eon or two ago I worked at a research foundation run by a chap who eventually became a multi-billionaire. On his office door was a sign: "Bring me solutions, not problems." I've always liked that concept, and that's the way I tend to look at things. A problem provides an opportunity to come up with a creative solution.

In the ham field we have a ton of problems, complete with endless on-the-air kvetching about them. What I seldom hear offered are proposed solutions. Just gripes. Hey, wake up and smell the garbage! So here's a challenge, if you're up to it. Take one aspect of amateur radio where there are problems which you find annoying (or worse) and see what you can come up with in the way of a creative proposed solution.

Let's take repeaters for instance. What's aggravating you about repeaters? What isn't? Have you got an old buzzard roosting on your repeater who has nothing to say and all day every day to say it? Or maybe you've got some cretins with a couth shortage who are fouling the air? Or maybe a kerchunker? Or some freeloaders? Or, on the other hand, an officious control op?

Instead of making yourself part of the problem with endless on-the-air complaints, how about giving what little of your mind that's left after being battered to an almost useless pulp learning the code a chance for some creativity? There are solutions to *any* problems. Step two is to figure out how best to implement your solution.

While I'd prefer you come to me with a success story of the problem, your proposed solution, and how you went about the implementation, I don't want any good ideas to die for the lack of initiative on your part. If you are too weak in the wooper to get results first and then write it up, at least write an article I can publish to help spark some other more alive hams into using your creativity for the benefit of our government sanctioned old white man's hobby.

If you're into contests, don't tell me you can't think of any improvements that could be made. Contests are the ham manifestation of male competiveness and the need to show who has the biggest . . . er . . . signal. I've had a great time with DX, VHF, and Sweepstakes contests. Of course, if I were going to do one again, I'd use a voice repeater to keep from having to call "CQ contest." Then how about another chip to give the repeatable part of the contest contact? That could be complete with voicing a incremented contest number.

Then there's the little problem of not being able to listen while you're transmitting. Hmmm. That's easy. All you need is two locations for your station, one for transmitting, maybe five miles away from your receiving site, with a 10 GHz control link to turn the beam and tune the VFO. No strain. We'll have your name up high on a list of almost-winners in *QST* or *CQ* yet. Just think how impressed the dozens of readers who bother to look at contest results will be to see your call listed! Wow!

Make a list of the problems that have been vexing you in your ham niche and let's see what creative solutions you have to offer. I'm waiting. The readers are waiting. Get off your duff, word process an article and send me the hard copy and a disk.

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the February issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

JAN 29

ODENTON, MD A Post Holiday Swapfest will be held at Odenton Vol. Fire Dept. Hall, 1425 Annapolis Rd., 8 AM-2 PM. VE Exams; pre-register with *Jerry Gavin NU3D, 7801 Overhill Rd., Glen Burnie MD 21060; Tel. (410) 761-1423, anytime.* Talk-in on 146.205/.805. For tables, contact *Tom Wilkison KA3OMU, 592 Eason Dr., Severn MD 21144. Tel. (410) 969-2639, eves.* Sponsored by The Maryland Mobileers ARC.

WHEATON, IL The Wheaton Comm. Radio Amateurs will hold their 28th Mid Winter Hamfest from 8 AM-3 PM at the Odeum Exposition Center in Villa Park IL. Call *(708) 545-9950* for general info. Talk-in on 144.790/145.390 MHz and 222.540/224.140 MHz. Commercial vendors pleas call or FAX *(708) 545-9950.*

FEB 4

ST. CATHARINES, ONT., CANADA The Niagra Peninsula ARC will hold their Big Event #17 Flea Market from 9 AM-2 PM at the C.A.W. Hall, 124 Bunting Rd. Talk-in on 147.24/.84. Contact *Marg Sewell VE3HOX, (905) 680-1211.* Advance payments can be sent to *NPARC, P.O. Box 20036, Grantham Postal Outlet, St. Catharines, Ont. L2M 7W7, Canada.*

FEB 5

LORAIN, OH The Northern Ohio ARS will hold its Winterfest 1995 at Gargus Hall, 1969 N. Ridge Rd Doors open 8 AM-1 PM; Setup at 7 AM. Flea Market and Commercial booths. For tables, contact *Dee Dee Ohman KA8VTS, 4122 Bush Ave., Cleveland OH 44109. Tel. (216) 398-8858.*

FEB 11

CHARLESTON, SC The 22nd Charleston Hamfest and Computer Show will be held 8:30 AM-4 PM at Charlestown Landing State Park, under the dome, just off Hwy. 171. Tell the person at the gate you are with the Hamfest and there will be no charge to get in the park. Talk-in on 147.18(+), 146.835(-), 147.27(+), 146.76(-), 147.30(+), 443.8(+), and 444.3(+). VE Exams will be given at Noon at St. Andrews H.S. on Wappoo Rd. Bring original and copy of your license, and any CSCE's you have, two ID's, one with a photo. Walk-in only; contact *Ed KC4OOZ, (803) 871-4368;* or *Gary AC4PL, (803) 766-3440.* Send advance payments to *Jenny Myers WA4NGV, 2630 Deliwood Ave., Charleston SC 29405-6814. Tel. (803) 747-2324.* Make checks payable to *"C.A.R.S. Hamfest Committee."*

FEB 12

FREEPORT, NY The Long Island Mobile ARC will host a Hamfest at Freeport Armory, 63 Babylon Tmpk., 9 AM-3 PM. VHF Tune-up Clinic. Talk-in on 146.25/.85. Contact *Neil Hartman WE2V, (516) 462-5549.*

MANSFIELD, OH The Mansfield Mid-Winter Hamfest/Computer Show will be held at the Richland County Fairgrounds in Mansfield, starting at 7 AM. Talk-in on 146.34/.94 W8WE. For info, tables, etc. send SASE to *Pat Ackerman N8YOB, 63 N. Illinois Ave., Mansfield OH 44905;* or phone *(419) 589-7133 after 4 PM EST.*

FEB 18

HORSEHEADS, NY The ARA of the Southern Tier will present a Hamfest at the NY State Armory, 128 Colonial Dr. Indoor Flea Market. New Equipment Displays. VE Exams start at 9 AM. Flea Market tables available on a first come basis. Doors open 7 AM-3 PM. Contact *Jack Slocum, (607) 739-4866.*

SALEM, OR The Salem Repeater Assn. and Oregon Coast Emergency Repeater Inc. will co-sponsor the 1995 Salem Ham-Fair at the Polk County Fairgrounds in Rickreal OR. Time: 9 AM-4 PM. Set up 6 PM-9 PM Fri. night and 7 AM Sat. morning. Talk-in on the 146.86 Rptr. Contact *Evan Burroughs N7IFJ, (503) 585-5924.*

TRAVERSE CITY, MI The Chenyland ARC 22nd Annual Swap-N-Shop will be held 8 AM-Noon at the Immaculate Conception Middle School. VE Exams at 1 PM, walk-ins accepted. Talk-in on 146.860. Contact *Chuck Mellberg W8SGR, (616) 946-5312*

FEB 19

DAVENPORT, IA The 24th annual Davenport (Iowa) ARC Hamfest will be at the QC-CA Expo Center in Rock Island IL. Flea Market. Commercial Exhibits. Talk-in on the W0BXR 146.28/.88 Rptr. For reservations or details, send an SASE to *Kent Williams K9UQI, 4245 10th St., East Moline IL 61244.* For VE Exam info, send an SASE to *Roger Franke K9AYK, 2506 E. 29th Ct., Davenport IA 52803.*

VANCOUVER, BC, CANADA The Burnaby ARC will host their annual Flea Market 1000Z-1400Z at Westminster Armouries, 6th St. at Queens, New Westminster BC. Setup at 0900 hrs. Talk-in on VE7RBY 145.35, or 442 85. For more info contact the Club Net *Monday nights at 2000 local time on 145.35,* or write the Club at *Box 72012, 4429 Kingsway, Burnaby BC V5H 4P9, Canada.*

FEB 25

BISMARCK, ND The Central Dakota ARC will hold its annual Hamfest at the Radisson Inn, 800 South Third St., 8 AM-4 PM. Talk-in on 146.85/.25. VE Exams. Ham/Computer Swapmeet. Contact *Tim N0SDB, (701) 663-6620;* or *Mark N0FAZ, (701) 255-7658.*

LAPORTE, IN The Laporte Civic Auditorium is the place to go to enjoy the Laporte Cabin Fever Hamfest. This event will be sponsored by the Laporte ARC, 8 AM-2 PM (Chicago time). Computer enthusiasts welcome. Talk-in on 146.610 (-131.8 PL), or 146.520 simplex. Contact *TX John @ (219) 362-1121,* or SASE to *P.O. Box 30, Laporte IN 46351.*

MILTON, VT The Radio Amateurs of Northern Vermont will sponsor the Northern Vermont Winter Hamfest at Milton H.S. on Route 7. Time: 8 AM-3 PM. Flea Market. Auction. Book Sale, more. VE Exams at 9 AM and 2 PM; Commercial exams at 2 PM. Tables free while they last. Call for large setups. Talk-in on 145.15 Rptr. Contact *WB2J8J at (802) 879-6589.*

FEB 25-26

CINCINNATI, OH The 1995 ARRL Great Lakes Div. Convention will be held at the Cincinnati Gardens Exhibition Center, 2250 Seymour Ave. Exhibits open at 8:30 AM Sat. and Sun. For details, call *Stan Cohen WD8ODQ, (513) 531-1011.*

FEB 26

LIVONIA, MI Livonia ARC will present its 25th "Silver Anniversary" Swap'n Shop 8 AM-3 PM at the Dearborn Civic Center in Dearborn. VE Exams. Talk-in on 144.75/5.35. For info, send a 4" x 9" SASE, *c/o Neil Coffin WA8GWL, Livonia ARC, P.O. Box 2111, Livonia MI 48151,* or phone *(313) 261-5486.*

NEW BERLIN, WI A Swapfest and Computer Fair sponsored by SEWFARS, 146.820 Reptr. Soc., MACE, and The Milwaukee Computer Club, will be held at Kuglitsch's Entertainment Center at 16000 W. Cleveland Ave. VE Exams. Reservation deadline is Feb. 11th. Make checks payable to SEWFARS/MACE Swapfest, and mail with SASE to *P.O. Box 102, Delafield WI 53018. Tel. (414) 771-1250; FAX (414) 542-7474.* Talk-in on 146.820 Rptr. LLBBS (414) 789-1034.

VIENNA, VA The 19th ARRL sanctioned Vienna Wireless Soc. Winterfest will be held at the Vienna Comm. Center. VE Exams will be held on Feb. 25th. Talk-in on 146.91 and 146.685. For info please call *Christine KE4HWE, (703) 560-7399,* or *Jorge KE4DGQ, (703) 729-4711.*

MAR 4

ABSECON, NJ The Shore Points ARC will sponsor its 13th annual hamfest, "Springfest '95" at Holy Spirit HS, on Route 9 (3/4 mi. south of Route 30. Doors open at 9 AM. Setup at 7 AM. VE Exams registration at 9:30 AM; testing at 10 AM. Flea Market. Talk-in on 146.385/.985. For info write to *SPARC, P.O. Box 142, Absecon NJ 08201.*

MAR 5

NORTHAMPTON, MA The 11th annual MTARA Amateur Radio Flea Market will be held at Smith Vocational School, RTE 9. Setup 8 AM. General admission 9 AM. VE Exams 10 AM; contact *Jim WA1ZUH, (413) 245-3228,* or *@ MTMBBS* via packet. Advance registration strongly recommended. The vendor contact is *Jim K1MEA, (413) 527-3199, eves. before 2200 EST.*

MAR 12

YORK, PA The 8th annual York Springfest (Ham & Computer) will be held at the York Fairgrounds starting at 8 AM. W5YI VE Exams at 8 AM. Talk-in on 146.97(-). For info and advance registration, call *(717) 843-7864,* leave message or FAX, or write to *York Springfest, P.O. Box 526, Red Lion PA 17356.*

MAR 18-19

FORT WALTON BEACH, FL The Playground ARC will hold their 25th annual North Florida Ham/Swapfest at the Ft. Walton Beach Fair Grounds, 8 AM-5 PM on the 18th; 8 AM-3 PM on the 19th. Giant indoor Flea Market. For tables, call *Bud K8YNU, (904) 243-5404, 9 AM-5 PM CDT;* or *Scott KE4BFT, (904) 244-3182, 5 PM-9 PM CDT.* For RV space only, call *Roberta, (904) 862-0211.* Address all inquiries to *P.A.R.C., P.O. Box 873, Ft. Walton Bch. FL 32549.*

APR 28-30

DAYTON, OH The Dayton ARA Inc. will hold their annual HAMVENTION at Hara Arena. Giant 3 day Flea Market. Exhibits. Activities for the Non-Ham. *FAX: (513) 274-8369; FAXMail (513) 276-6934. BBS via America Online: (513) 276-6930;* Keyword "Ham", select "Hamvention"; License exams by appointment only; call FAXMail or BBS for details. Mailing address *Hamvention, Box 964, Dayton OH 45401-0964.* Advance registration deadline is Apr. 1st for Canada, Apr. 8th for the USA Flea Market tickets by advance registration only. Free bus service will be provided between Hamvention, Air Force Museum, Salem Mall and Forest Pk. Mall parking areas. Please call BBS or FAX-Mail for info.

SPECIAL EVENT STATIONS

JAN 28

YANKEE SPRINGS, MI The Bany County A.R.E.S. Team, a div. of the Bany Comm. Network (BACON), will operate KG8KL 1300Z-1800Z in conjunction with the 14th Gun Lake WinterFest. Operation will be in the General portions of the 80, 40 and 20m bands, and if conditions permit, 15m. Novice CW portion of the 80 and 40m bands; and Novice voice portion of the 10m band, if conditions permit. For a QSL certificate, send a #10 envelope and return postage to either *N8ZSG, 89 Woodstrail, Delton MI 49046;* or *KG8KL, 118 S. Hanover, Hastings MI 49058.*

FEB 3-5

SAN PEDRO, CA The United Radio Amateur Club will commemorate the 50th Anniversary of the ST695 Angels Gate tug boat by operating Station K6AA 10 AM-8 PM Fri., 7 AM-8 PM Sat., and 8 AM-5 PM Sun., local time. Operation is planned for 10m SSB, 15m CW and SSB, 20m CW and SSB, and 40m CW and SSB. Write *URAC, Los Angeles Maritime Museum, Berth 84, Foot of Sixth St., San Pedro CA 90731.*

FEB 11-12

WEST PALM BEACH, FL A Fox Hunt will be sponsored by the West Palm Bch. ARC, 1400 UTC-2000 UTC Feb. 11th and 1700 UTC-1900 UTC Feb. 12th. This event is open to all interested parties, licensed and unlicensed. To register, send $1.00 donation and registration request to *Fox Hunt, c/o Dick Schofield KE4CGQ; Sam Falco KD4VGI; or Dennis Hamilton AD4PS, P.O. Box 6834, West Palm Bch. FL 33405-6834.* Feb. 10th is the registration deadline. Obtain official WPBARC Fox Hunt Logs from KE4CGQ, KD4VBI, or AD4PS at the address above.

FEB 18-19

MT. VERNON, VA The Mt. Vernon ARC will operate Station N4BV from 1600Z-2000Z both days, to commemorate George Washington's birthday. The station will be located on Washington's Mt. Vernon Estate. Frequencies: Lower General 80m-15m phone and CW subbands, Novice 10m phone subband, and 2m packet @ WA3TAI.MD.USA.NOAM. For a certificate, send QSL and a 9"x 12" SASE to *Steve Schneider WB4EEA, 8602 Cushman Place, Alexandria VA 22308.*

FEB 25-26

GLENVIEW, IL The Lake County (IL) RACES/ARES Group will operate N9US from 1500Z Feb. 25th-2100Z Feb. 26th, observing the end of flight operations at Glenview Naval Air Station (after 58 years of naval air service). CW - 3.580, 7.035, 14.030, 21.140; Phone - 3.880, 7.280, 14.280, 21.320, 28.430; OSCAR 10/13 satellite 145.910, Packet 145.03. For a certificate, send QSL and a 9" x 12" SASE to *Lake County RACES/ARES, 1303 North Milwaukee Ave., Libertyville IL 60048.*

GRANDE PRAIRE, ALBERTA, CANADA Members of the Peace Country ARC will operate CQ6ARC from the site of the 1995 Canada Winter Games. Operation will be from 1700Z-2300Z each day, around 14.240 MHZ(+/-); also, Satellite AO-27 and FO-20, as conditions permit. For a certificate, send QSL and a 9" x 12" SASE to *CG6ARC, P.O. Box 767, Grande Prairie, Alberta, Canada T8V 3R5.*

VIRGINIA BEACH, VA The Virginia Beach ARC will operate WA4TGF 1400Z Mar. 25th-2000Z Mar. 26th, to commemorate the 104th Anniversary of the NORWEGIAN LADY. CW—10 kHz up from the bottom of the Novice subbands; Phone - 3.880, 7.280, 14 280, 21.280, 28.363, and 146.550. For a certificate, send QSL and SASE to *VBARC, P.O. Box 62003, Virginia Beach VA 23462.*

PROPAGATION

Number 25 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 E. Chateau Circle
Payson AZ 85541

The outlook for February seems generally favorable in spite of declining sunspot numbers, with a few days which are expected to be Poor or Very Poor (see the chart) due to ionosphere disturbances. The remaining days ought to provide reasonable opportunities when *Good, Fair, or trending* conditions may be expected. You can improve your DX chances by listening to WWV at 18 minutes after any hour for updates on propagation conditions and coordinating their reports with the accompanying charts to pick and choose the most likely days, times and bands to operate.

As I write this on November 30th, I am pleased to note that about mid-morning local time there were some short-skip signals on 17 meters with strengths of S8 to S9. Today was predicted to be GOOD on the November chart. Although I don't listen regularly to 17 meters, my QSO with a Minnesota station proved the need to listen regularly—even on bands that might not be considered favorable, or on days and at times when DX is not expected, and send out a CQ into an apparently very quiet band with few or no signals.

10 and 12 Meters

Only occasional F2 openings to the tropics on GOOD days during daylight hours. Not much sporadic E or short skip propagation can be expected. Skip is where you find it, so keep looking and hoping. Sometimes results are spectacular on a supposedly "dead" band. Really good "gain" antennas can help a lot this month. A good local band.

15 and 17 Meters

Fairly good DX into the Southern Hemisphere during daylight hours from noon to sunset *local* time, and short skip from sunrise to sunset, but expect the band to close soon after—abruptly!

20 Meters

Daylight hours should be pretty good for DX this month in spite of depressed conditions in general, and you may even find the band open until midnight. Peaks ought to occur just after sunrise and late afternoon *locally*. If the band does stay open after dark, look for openings into South America and even Antarctica. Also, during the day, you will find considerable short skip. All of which means that 20 meters should be your PRIME DX BAND. (See 80 meters, too.)

30 and 40 Meters

Expect late afternoon and evening openings into Europe and Africa swinging south after sundown for a few hours, but the MUF falls below 7 MHz later in the evening. Short skip will occur during most days out to 1,000 miles or so, and to 2,000 miles at night until the band closes.

For you newer operators who have not lived through a complete sunspot cycle, there will be some great surprises in store. Listen and learn.

80 Meters

This will also be a very good DX band after dark, and since QRN is low, signals ought to be very readable . . . even weaker ones. Peak DX occurs around midnight local time and just before sunrise. Insomniacs will *love* 80 meters this month. Short skip at night will occur frequently out to 2,000 miles. Isn't it interesting how two of our "oldest" bands, 80 and 20, are the best in these times? The old-timers knew what they were doing when they "got" these bands for amateurs way back when.

160 Meters

You "top band" operators will love this band in December: DX openings to the east from your locations, peaking around midnight (Europe, etc.), and toward the south and west before sunrise. Nighttime short skip should also be good from dusk to dawn, getting longer later. On this band, use vertical antennas to transmit and horizontal antennas for receiving, preferably Beverage antennas if you have the room. Low noise and minor static will make you happy. 73

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
EASTERN UNITED STATES TO:												
ALASKA							20	20				
AGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15*	15*
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15*	15*
INDIA	20/40					20*	40*	20*				15
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40*	40*				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WESTCOAST		80	80	40	40	40	20	20	20			
CENTRAL UNITED STATES TO:												
ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15*	20*	20*				40*	20*	20*			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R.	40		40	40				20	20			
WESTERN UNITED STATES TO:												
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40*	40*							15	15	20
U.S.S.R.		40*	40*	40*	40*				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

FEBRUARY 1995

SUN	MON	TUE	WED	THU	FRI	SAT
			1 F	2 F-G	3 G	4 G-F
5 F	6 F	7 F	8 F-G	9 G-F	10 F-P	11 P-VP
12 VP-P	13 P	14 P-F	15 F	16 F-G	17 G	18 G
19 G-F	20 F	21 F	22 F	23 F-G	24 G	25 G
26 G	27 G	28 G-F				

BARTER 'N' BUY

Number 26 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rt. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the April 1995 classified ad section is February 9, 1995.

Number 27 on your Feedback card

NEW PRODUCTS

Compiled by Charles Warrington WA1RZW

SOFTWARE SYSTEMS CONSULTING

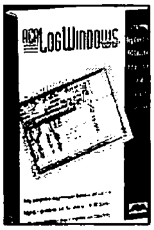
SSC has begun shipping version 4.0 of the PC GOES/WEFAX software/hardware system. PC GOES/WEFAX 4.0 is for the IBM PC and compatible computers and allows users to receive and process weather satellite pictures directly from weather satellites on VHF, microwave, or from shortwave frequencies.

The package includes a radio facsimilie modem that connects to the PC serial port and to the radio receiving equipment, image processing software, a comprehensive 300-page manual, broadcast schedules, an orbital prediction system, and a tutorial audio cassette.

Suggested retail price for the package is $250. For more information or to order visit your favorite dealer or contact *Software Systems Consulting, 615 S. El Camino Real, San Clemente, CA 92672; (714) 498-5784.* Or circle Reader service No. 202.

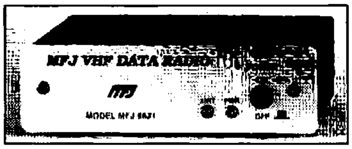
ADVANCED ELECTRONIC APPLICATIONS

AEA has announced delivery of Log Windows 2.0. Logging, rig control, and DX cluster monitoring with award tracking and reporting—it's all part of AEA's newest Log Windows 2.0.



This new version is compatible with PC PackRatt for Windows version 2.0 as well. Antennas can be tuned to the short path, long path, or any other direction with the simple click of a mouse. A new database browser allows you to sort and print logs by any criteria. Users can also enjoy on-line *Callbook* databases at any time.

There are additional features to this product far too numerous to mention. The suggested retail price for Log Windows 2.0 is $99. Upgrades are available. For more information or to order, visit your favorite dealer or contact *Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood, WA 98036; (206) 774-5554, FAX (206) 775-2340.* Or circle Reader Service No. 203.



MFJ

The new MFJ-8621 Data Radio will monitor "packet only" on your favorite packet channel for continuous 24-hour-per day duty. It won't stop monitoring packet unless you want it to.

This new radio is a 2 meter FM data receiver that will run all data rates through 9600 straight out of the box.

Simply attach a TNC cable, antenna, and 12VDC supply and you're receiving high-performance error-free packet. The unit is priced at $119.95. For more information or to order contact *MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762, (601) 323-5869, FAX (601) 323-6551.* Or circle Reader Service No. 206.

TOOL PAK

Tool Pak has introduced the new

Tool Vest for the serious radio amateur. The Tool Vest is designed for the worker who wants all his tools conveniently available without compromising safety. The Tool Vest easily fits over clothing, adjusting to a wide range of sizes with four expandable side release buckles. It is particularly well-suited for working in high places.

20 front pockets organize those tools you always need. One large rear pocket is accessable from both sides. Bright panels front and rear aid visibility.

The Tool Vest is priced at $54.97. For more information visit your favorite dealer or contact *Tool Pak, 7307 82nd St. Ct., SW Tacoma, WA 98498, (206) 584-4914, FAX 589-1091, (800) 258-8458.* Or circle Reader Service No. 207.

AZDEN

Enjoy true 9600 baud packet radio on 440 MHz with Azden Corporation's newest 35 watt digital packet radio, the PCS-9600D.

The PCS-9600D transceiver incorporates all the special features required by high speed packet radios. The rig features 35 watt high power output, 20 kHz wideband IF, wide frequency range from 430-450 MHz and solid state diode TX/RX switching. A full TouchTone microphone is included for voice operation when needed.

The unit is priced at $649. For more information or to order visit your favorite dealer or contact *Azden Corporation, 147 New Hyde Park Road, Franklin Square, NY 11010; (516) 328-7500, FAX (516) 328-7506.* Or circle Reader Service No. 208.

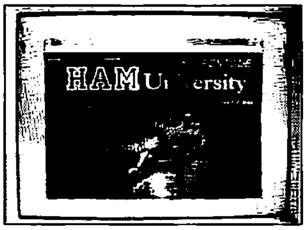
SESCOM

SESCOM, Inc. has released its new 1995 Constructor's Catalog. This updated and expanded booklet features new and innovative electronics packaging solutions along with hard-to-find items. It also serves to introduce SESCOM's two newest product lines.

The RACKEM 'N' STAKEM Series is a comprehensive line of half-rack-sized boxes, racks and mounting accessories.

The BOX-IT System is designed to make constructing easy and fast. BOX-IT boxes are available in many sizes and panels are cut to assorted sizes and simply slide into the boxes' rail system. These common hole sizes and patterns are prepunched to eliminate work for the builder. A variety of components are also available for small-quantity purchases.

For more information or to receive a catalog contact *SESCOM, Inc. 2100 Ward Ave., Henderson, NV 89015-4249; (702) 565-3400, FAX (702) 565-4828.* Or circle Reader Service No. 204.



AMATEUR RADIO EDUCATION

Amateur Radio Education, a new company specializing in software products, announces "Ham University," a new Windows program for learning amateur radio theory and Morse code for all license levels. An interactive game called Pentode makes learning the code and speedbuilding fun.

The program uses Hyper-Text help files to assist the student in better understanding the theory behind each question and answer. System requirements are a 386 computer or better, Windows 3.1, DOS 5.0 and a sound card for the Pentode Morse code game.

For more information contact *Amateur Radio Education, Inc., 19302 Pauline Lane, Huntington Beach, CA 92646; (714) 968-0042, FAX (714) 965-1016, Internet BGREGG@CAL-SOFT.COM.* Or circle Reader Service No. 205.

TOWER JACK

Hams know that taking down tower sections can be a backbreaking chore. You don't have to go it alone anymore with the introduction of the new Tower Jack product.

This sturdy device will help you dismantle tower sections whether you're up 15 feet or 150 feet. Pictured here is Tower Jack's inventor Jeanene N5UHL with OM Kenny WB5JLZ demonstrating her new patented tool.

The Tower Jack is priced at $49 retail, $36 ham net. For more information or to order contact *Tower Jack, P.O. Box 82321, Baton Rouge, LA*

70884-2321; (504) 924-7708. Or circle Reader Service No. 201.

73 Amateur Radio Today

MARCH 1995
ISSUE # 414
USA $2.95
CANADA $3.95
A WGI Publication
International Edition

Build Your Own WX Satellite Receiver

Easy HF Satellite Antenna

RF Grounding in the Shack

More 73 Reviews

S&S Programmable Counter
LOGic 4 Software
Ham University
Azden PCS-7200

Go 220 MHz Mobile!

THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

MANAGING EDITOR
Hope Currier

SENIOR/TECHNICAL EDITOR
Charles Warrington WA1RZW

EDITORIAL ASSOCIATE
Joyce Sawtelle

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Charles Warrington WA1RZW

GRAPHIC DESIGN
Suzanne Cole

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

GRAPHICS MANAGER/ PAGINATION
Linda Drew

CIRCULATION
To subscribe: 1-800-677-8838

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article
Back issues: $4.00 each

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

March 1995
Issue #414

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

Build your own satellite receiver and produce images like this fine summer shot of Europe in your own shack. This transmission was received at Z6SAT in Johannesburg, South Africa. *To learn more, please turn to page 10.*

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: Up, up, and away! This photo was taken from a balloon 95,000 feet over Madison, Wisconsin. The balloon was equipped with GPS and a digipeater facilitating 400-mile QSOs. Photo courtesy of Tim Tomljanovich K9SB, Near Space Science Group. A one-year subscription/extension goes to Tim for this FB photo in the 73 Photo Search

FB

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458.

For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34 21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: Possession of this magazine constitutes a contract with Uncle Wayne and The Team to just say no to LIDS and conduct a stimulating, intelligent QSO today!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Yes, I'll Be At Dayton This Year

But, as far as I know (and I know pretty far), I won't be speaking this time. However, since less than 1% of the HamVention attendees usually bother to squirm and sweat through one of my endless talks, I doubt I'll be much missed.

Sure, I'd do much better to pick one subject and stick to it for maybe a half hour and then get off the pot . . . er . . . podium. But there are so many interesting things to talk about, and I want to cover them all, that my allotted two hours just barely gets me started.

One of the reasons amateur radio is a hard sell to potential hams is because it's so difficult to explain. Sure, working DX is a part of it. A small part, really. The ham host of a talk show recently said he'd counted 57 different sub-hobbles that make up hamming. I've never tried counting 'em before so I decided just now to see how many I could come up with. I had no problem with counting 53 separate aspects of the hobby that I've pursued down through my 57 years of hamming, and 20 more that I haven't done yet. That added up to a serendipitous number.

How can I cover a 73-hobby group of interests in a two-hour talk? It's worse than that, of course, because I can't help bringing up ham radio history to explain why things are as they are now . . . and what I see ahead for us, drawing on that past. Plus I've been known, on rare occasions, to talk about non-germane subjects like computers, cold fusion, our terrible American school system, and so on. And even to tackle religious matters such as our beloved reminder of Mr. Morse . . . also known by thinking hams as Sam's Curse.

Why Dayton In 1995?

As I explained in an editorial last year, when we here at *73* looked over the cost vs. benefits of exhibiting at Dayton, it didn't make any fiscal sense. With booth costs going through the sky, the cost of flying in an editor, an advertising sales person, and someone to run the booth, plus Wayne to swagger around looking important, and counting the cost of rented cars, hotel rooms, meals, and so on, the tab was up in the thousands. Then there is the cost of shipping the exhibit booth both ways, plus magazines, books, and so on. Offsetting this we might sell a couple of hundred subscriptions, if it is a particularly good year. With a HamVention special of $15, that's maybe $3,000. Sure, that would be pretty good if it didn't cost anything to print and mail the magazine or pay for the staff to produce it.

Why not more sales? Because most of the active hams are already getting *73*. They come by the booth and tell us how much they like the magazine and how they read and enjoy my editorials, though they don't always agree with them. Worse, many of the subscriptions are renewals, so we just get less for the subscription and don't gain as many new readers.

The hams who haven't been reading the magazine have no idea what they're missing, so they don't bother to stop by the booth. Many of them are too busy in the flea market to come inside, even when it rains. Which it always seems to do.

Another big problem with getting new subscribers is that over half of the licensed hams don't subscribe to any ham magazines. They're not involved with much more than talking over a local repeater or rag-chewing on 75m, so they have little interest in knowing what's new or trying packet, satellites, and so on.

In the face of all that, it didn't seem like we had much to lose by not shipping in a team from *73* to run a booth. If we took the same money that it would cost to do the booth and invested it in sending direct mail letters to hams, we'd pull around 3-5% in subscriptions. $4,000 would allow us to mail around 10,000 letters. At a 3% response, that's 300 new subscribers at $20 each. Get out your hand calculator and you'll see why that beats exhibiting by a long shot. We don't even lose the work on the magazine the staff could be doing during their several days away.

The Big Four-O

So why, with all that, will Wayne be there in 1995? With a booth! Well, the biggest reason is that this celebrates 40 years since I first exhibited at the HamVention, back when it was in the Dayton Biltmore Hotel downtown. I haven't missed many years. I wonder if there is anyone else who's been coming to the HamVention for 40 years? I'm pretty sure no one else has been exhibiting for that long. Or that anyone else has given nearly as many talks.

When we stopped exhibiting I was not really surprised that last year the committee decided to move my talk to Sunday morning, after about half of the attendees would be already heading home. I got their message and didn't bother to come.

This year, Sherry said what the heck, let's just you and I go. She offered to run the booth so I could go around to see exhibitors and shake hands with old friends. If you've read any of my travel reports you know how cheap Sherry and I travel. Make that economically, it sounds better. If you haven't read my reports yet, for shame, you're missing out. I'll try to remember to bring some to Dayton so you can rectify your serious oversight. I should bring a few copies of my book to autograph too. They sold like crazy at the last few hamfests I've attended.

We buy yearly senior passes on Continental Airlines, which keeps the cost of our flights to a minimum. Well, you'll find out all our economy secrets when you read my travel stories. Who else could fly first class to Munich with his wife, rent an Audi and drive to Vienna, Prague, Krakow, and back to Munich, staying in very nice hotels, visiting hams in each city, and keep the total cost for the flight, car rental, hotels, and meals under $1,000?

The major expense for the HamVention will be for the booth space, so I hope you'll grab some friends, bring them to the booth, force them to subscribe to both *73* and *Radio Fun*, and buy some of my travel reports. I'll try to spend as much time there as I can so I won't miss you...and I'll be autographing my book, *Declare War*.

Hey, if you make it worth my while, I might celebrate my 41st year at Dayton next year. They're finally changing the HamVention dates next year so it won't come on the same weekend as my WWII submarine crew reunion. I want to get down to Mobile, where our old boat is on display, to celebrate the 51st year since I last sailed on the Drum. I joined the boat in 1943 and was on its last five war patrols. It was an exciting time, with us sinking lots of ships and the Japanese dumping hundreds of depth charges on us. I've a $7.50 book telling just what it was like. It is made up mostly of reprints of the wartime recollections I wrote for the *Drum Newsletter*, which I published for several years. I've included the Amelia Earhart inside story in this book. Exciting stuff.

Say, if you get a chance, how about dusting off your word processor and letting me know how many years you've been going to the HamVention, what you do there, what bargains you've found, and so on. You might have some interesting stories for *Radio Fun* which would encourage new hams to start coming to Dayton.

For those of you who've made an annual pilgrimage to my talks, I'm sorry I won't be speaking this year. It'll probably be a while before I get back enough in the good graces of the chaps running the show to get on the program with a good time slot again. But, since I don't have anything much of importance to say anyway, you won't have missed much. I may come up with a tape of what I might have said that you can buy. Or a booklet. Unless the cold fusion field breaks wide open and keeps me too busy, which is possible.

Almost probable. I'll be attending the fifth cold fusion conference in Monaco three weeks before the HamVention, so I'll have the latest news on what scientists from all around the world are doing in this incredible new field. I'll try to bring enough copies of the latest issue of *"Cold Fusion"* for you. They've also been selling out at hamfests. Selling out much faster than I ever expected. Golly, I haven't been to Monaco in years! I remember my first time in 1958, when I visited Bill Orr W6SAI who was summering there with his family. We later became enemies when I opposed "Incentive Licensing" in 1963 and he was being paid to promote it.

This cold fusion business has faxes coming in from my technical advisors in India, France, China, Australia and the US. Maybe you missed the articles in *Scientific American* on sonoluminescence (Feb. '95).

While Sherry and I are in Europe for the conference we'll take a day or two to visit Paris Disneyland, and another to do the Chunnel train to London, where I'll be getting together with Ron G4OWY. I sure wish you could come along! It's going to be a wonderful conference and trip. Yes, I'll make a day-by-day report available.

Speaking of trips . . . a reminder. If you know or talk to any hams on Yap, Palau, Pohnpei, Truk or Majuro, please let me know how I can get in touch with them. Sherry and I will be visiting there this coming November.

Continued on page 7

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Edward Hutton N3KEX, Oakdale PA I enjoy ham radio tremendously . . . I've worked as a tech in different categories after my discharge, and have always gravitated to the VHF/UHF bands. I have a couple of gripes. After I hear some of the crap on the HF bands, I seriously question the CW requirement . . . why would I want to put up with it? Hams had better start using our other bands, especially the microwave bands. We won a fight over proposed loss of some of these bands; use 'em or cry over them after we've lost 'em, I say. More of us need to utilize 6 meters, my favorite band. Repeater owners/trustees who carry "ghost" repeaters in the repeater directory had best stop this practice . . . one day I'll claim one of these pairs and get my own machine on line. Not my problem if they don't like it.

Six meters is most likely one of our least utilized bands. I'm glad to see manufacturers coming out with new 6 meter mobile rigs, a very smart move. I predict plenty of newcomers to this band . . . I know I will be very happy to greet them.

I enjoy hilltopping with my different radios . . . 6, 2, 220 and 440 capability here. I like to run QRP and see how far I can go; if I don't make any contacts, I still have fun. I try to take some people with me, and hope the practice spreads.

I like to use FM during VHF/UHF contests . . . I never score a lot of points. This irritates the Grandaddies, but it gets plenty of new hams, mostly no-coders. Hell, I'm a no-coder, and may even renew my license as such. I go to school three nights a week, have a wonderful two-year-old son, a baby girl is due in 30 days (she will probably be here by the time you read this), so learning the code is not very high on my list of priorities. Oh yes, I even hold a full-time job—I'm a field technician for Bell Atlantic Network Integration. We install, maintain and administer LANs and WANs. The wireless LAN is coming!

Mr. Green, I truly enjoy your magazine! I promise to talk up *73;* you just keep those good articles coming.

Emory Schley N4NCU, Dunnellon FL Wayne, you did it again! In your January 1995 editorial you mentioned the two "twin-three" antennas you erected during your college days. I believe this is the *same* antenna you said you were going to publish the specs on, in one of your previous columns (about 10 years ago, as I recall). I know you're a busy guy, so I've been patient, but come on—give us the lowdown. Another couple of years and I won't be able to erect antennas any more! Please! Make that *pretty* please!

Emory—I tried to find that confounded Twin-Three or Twin-Triplex antenna in a recent Handbook, *but it's gone. I found it originally in CO around 1946. It then was in the* Radio Handbook *for a while. But never mind, I remember the specs. It has two three-wire dipoles spaced 1/6th wave apart. that's about 10' for 20m. I used two 10'2" x 2" poles to hang it up. I used rope to the ends of the poles to swing the whole works between two trees or one tree and the house. The three-wire dipoles were made with #14 wire spaced 6" apart. Each dipole is thus 12" wide. Dipoles for 20m are about 32' long. The ends of the three wires are connected and the center element of each dipole is fed with 150-ohm feedline 1/4 wave long (16'). Hmm, do they still make 75- and 150-ohm twinlead? These are connected together, but with the phasing reversed, and fed, in turn, with 300-ohm feedline to the shack. During the high sunspot cycle this baby puts out one whale of a signal at a very low angle broadside to the elements. It's bidirectional, so I had a whopping signal in Europe and the South Pacific with one, and Africa and Asia with the other. You can do a fair job with the ZL-Special antenna which is about the same, but uses 300-ohm twinlead for the dipoles. This was invented by good old W8JK. I had two of 'em swung between two trees and my fraternity house when I was in college. They were about a half wave above the ground. I hung the 10m Twin-Three in the middle of the 20m antennas. . . . Wayne*

John W. Slack WA2BGB, Sunrise FL The other night I tuned in on 17 meters and heard a gentleman working remote. He was working 220 MHz through 440 MHz and working on 17 meters. He was experimenting with his audio quality. As it turned out he had hum and some highs on his audio. As his contact went on, some of the *pro* radio operators got on with nasty comments about his signal.

When I started in radio we were amateur radio hams. If someone had a problem with a rig we put our heads together and tried to help our fellow ham.

I hope this letter will help make some people think before they destroy what radio is all about. It is amateur radio, not *pro* radio, we as hams are in.

Scott Rorex KI5FC, Imboden AR Wayne, I always read your "Never Say Die" editorial as soon as I receive my issue of *73 Amateur Radio Today.* Thanks for the many ideas and encouragement you have provided. I have used some of them, just haven't taken time to give you credit for them. I will try to fix that now.

I at least give you partial credit for my deciding to start my own business using PC-based Interactive Voice Systems in 1991. Most of our systems are used for inbound telemarketing and we now process hundreds of thousands of calls per year. Also, I recently started learning international marketing, which is very interesting, plus goes well with my interest in amateur radio.

Also from your encouragement, I began working with our local school principal, science instructor and computer instructor at Sloan-Hendrix High School with the idea of establishing a school club. We decided that we could interest more students and adults by working with technology in general while emphasizing amateur radio. Our club's name is North East Arkansas Technology Club (NEAT Club). To generate a little excitement, we organized an open house with amateur radio HF voice, 2m voice, and 2m packet demonstrations, as well as other technology related to amateur radio. For example, radio control model race cars, radio control model airplanes and radio control model helicopters. In addition to these, several PC-based exhibits, such as word processors, spreadsheets, games, CD-ROM, and Interactive Voice were included.

Amateur radio demonstrations were set up and operated by other amateur radio clubs located in Northeast Arkansas. Thanks to the Jonesboro Amateur Radio Club, the Respond Amateur Radio Club, and the Lawrence County Amateur Radio Club for helping with the open house.

We were pleasantly surprised when the regional TV news crew arrived to do a story on the Technology Club's open house. The story was aired during the evening news and night news.

Ron Gang 4X1MK, Kibbutz Urim, Israel I was your longest consistent contributor to the "73 International" column for the past 11 years. Anyone reading my contributions over that period will find a complete chronicling of the remarkable growth and development of amateur radio in Israel.

Warm Ham Ties Between Israel and Jordan Developing: The world was heartened to see the signing of a peace treaty between the leaders of Israel and Jordan. This took place not in some faraway foreign capital, but right on the border between our two countries.

What typifies this developing peace is the warmth of feeling between the people of the two countries and the wholehearted manner in which His Majesty King Hussein has gone into the negotiations and peace-making. The same feeling is found with the Jordanian people themselves, and this is indeed the way a peace should be made!

In amateur radio, as in politics, a lot has been going on behind the scenes. I am still not at liberty to disclose what ham contacts have been before the overt peace process between JY and 4X began. But now embassies have opened, there is mutual tourism between the two countries, and by the time you read this joint ham projects between the amateurs of the two countries should be underway.

In the late summer, shortly after the first public meeting between Prime Minister Rabin and King Hussein in Washington, I nearly fell off a Jerusalem park bench when my CQ on the local repeater was answered by a Jordanian ham in Amman. Other JY hams appeared on the Israeli repeaters and we were impressed by the true warm friendliness of these contacts.

On September 22, 1994, a teenage ham in the town of Arad, Jonathan 4Z9FHB, hunting nearby DX, called CQ on the Amman repeater and was answered by none other than King Hussein JY1 himself! They chatted for four full minutes, during which Hussein passed on his warm greetings to all the radio amateurs of Israel.

In early October, still with no official ties between Jordan and Israel yet, the first Jordanian amateur visited Israel. Eli 4X4FD of Beersheva learned of the upcoming business visit, phoned up the Jordanian ham who he had already chatted with on the air (direct telephone lines already operating between the two countries) and invited him to stay with him and his family. One evening the JY4 ham stayed with Leslie 4Z5DG at Kibbutz Re'im, and about a dozen southern hams arrived to meet with our new Jordanian friend.

We learned from him that the hams in Jordan were quite keen about ties with Israel. Peace gave them access to 10 VHF and four UHF repeaters in Israel in addition to their UHF and VHF machines in Amman, access to the 4X packet network (and through it a gateway to the world system) and, in short contact with hundreds of active hams in Israel, greatly enriching their enjoyment of our hobby. We were impressed with the nobility and gentlemanliness of our guest. QSLs for the eyeball QSO were exchanged and, above all, all who were at the get-together came away with the genuine feeling that we had gained a new friend, the greatest of all gains!

There have since been more meetings. Joint projects are planned, like a new repeater to serve both countries on one of the higher mountains in western Jordan. A joint special operation on the international border is planned, with two callsigns: 4X4-SALAM ("peace," in Arabic) and JY-SHALOM ("peace," in Hebrew).

For years, the psychological distance between Israel and Jordan was vast, South America seeming closer. Yet suddenly we see how close we are to each other! Amman is but an hour's drive from Jerusalem, and soon cars from each country will be allowed to freely cross the border. Thus we can expect many eyeball QSOs, antenna raising parties, and who-knows-what. May the future be full of light and joy for us all.

Note: I have purposely not named the Jordanian hams involved (excluding JY1 himself, of course) at this time. The pace of events has been quite rapid and, as is well known, there are more than a few violent opponents to Jordan's ties with Israel. Since some of our new friends have business ties in the rest of the Arab world and have to live peacefully in their reality, I didn't want to cause them any discomfort by naming them. This is out of a deep feeling of respect for our Jordanian colleagues whose sincerity I don't doubt for a minute.

I'm sure glad to hear that His Majesty JY1 is still active on repeaters. I remember 22 years ago when I smuggled a suitcase with a Standard 34-94 repeater and several HTs through British and Jordanian customs on my way to visit His Majesty. With the help of Blackie JY9BB, I set the repeater up on top of a hill across from his downtown palace so it could cover the whole Amman area. Its call was JY73. With my new call of JY8AA it was fun saying goodbye to His Majesty, who was at the palace using my old Motorola HYT-220, as I boarded Alia flight to Cairo from way out at the airport via the new repeater. . . . Wayne

QRX . . .

Number 3 on your Feedback card

Westlink Goes Under

A major ham newsletter has bitten the dust after 13 years and 330 issues. Publisher Burt Hicks WB6MQV announced that the January 1, 1995, issue of the *Westlink Report* would be the last. "I would like to think that what we have done in the past thirteen years has made a difference for good in the hobby. We know we have influenced some decisions of the Federal Communications Commission as well as informed a few members of Congress, and perhaps helped shape the public debate on issues of interest to amateurs," said Hicks.

The demise of *Westlink* is not a total surprise. The newsletter has been fighting a well-known financial struggle for about eight years. But Hicks says it was lack of ZZZs rather than lack of $$$s that finally caused *Westlink* to fold. He says four to five hours of daily sleep is simply not enough to keep publishing *Westlink* while working the graveyard shift as a Fox Television Engineer.

There are only two other national newsletters comparable to the *Westlink Report:* the *ARRL Letter* and the *W5YI Report*. Hicks calls the League's newsletter "professionally done," but adds that it lacks editorial freedom. The *W5YI Report*, on the other hand, had only three amateur radio stories in the last issue received. *W5YI* was also responsible for erroneous reports of a major financial disaster here at *73*. The *W5YI Report* based that story on interviews with disgruntled former Wayne Green, Inc. employees. *TNX Westlink Report, No. 687, January 1, 1995.*

Vibroplex Bought by Ham

The venerable Vibroplex company, manufacturer of the original "bug" and a number of other types of keyers, has been acquired by Mitch Mitchell, Jr. WA4OSR. Mitch says "The Vibroplex name is older than amateur radio and has come to represent the one piece of equipment in the ham shack that symbolizes the interest, comaraderie, and espirit de corps of the worldwide ham radio community."

Besides the bug, the company plans to continue manufacturing lambic, Vibrokeyer, and Brass Racer keys at consolidated headquarters in Mobile, Alabama. Mitch also hints that some new products will be introduced from Vibroplex very soon.

Social Interface Coming

Microsoft Chairman Bill Gates said, "We are just at the beginning of the social interface," in a recent article in *Electronic Engineering Times*. His comments were made in conjunction with the release of Microsoft's new Graphic User Interface (GUI) named "Bob," which was recently unwrapped at a major Las Vegas consumer electronics convention. "Bob" uses cartoons instead of icons and menus as a means of communication between human beings and computers.

"Bob" sits atop Windows and allows users to toggle back and forth to the cartoon characters at any time for assistance. Smiley faces, cats, and parrots all greet the user in colorful "rooms" which represent basic aspects of the program, such as e-mail or word processing. Gates says this type of social interface is a key component in realizing the vision of the home filled with smart devices. In an effort to make these devices fun to use, researchers have determined that humans tend to relate more easily with animated beings in a polite, interactive manner, almost as if the device were human.

While some observers found the "Bob" GUI a little too cute, many others are expected to jump on the bandwagon. Expect to see more and more electronic attempts at social interfacing, especially in markets filled with members of the maturing MTV generation. *TNX Electronic Engineering Times, January 16, 1995.*

FAR Scholars Sought

The nonprofit Washington, D.C., based Foundation for Amateur Radio will once again coordinate the distribution of 56 scholarships from a variety of donors for the academic year 1995-96. Licensed radio amateurs may compete if they plan to persue full-time studies beyond high school and are enrolled or have been accepted for enrollment at an accredited university, college, or technical school.

The FAR Scholarships range in value from $500 to $2,000 each. Some have restrictions. More information and an application form may be requested before April 30, 1995, from *FAR Scholarships, 6903 Rhode Island Avenue, College Park, MD 20740. TNX W5YI Report, January 15, 1995.*

AMSAT Phase 3-D Under Construction and On Schedule for April 1996 Launch!

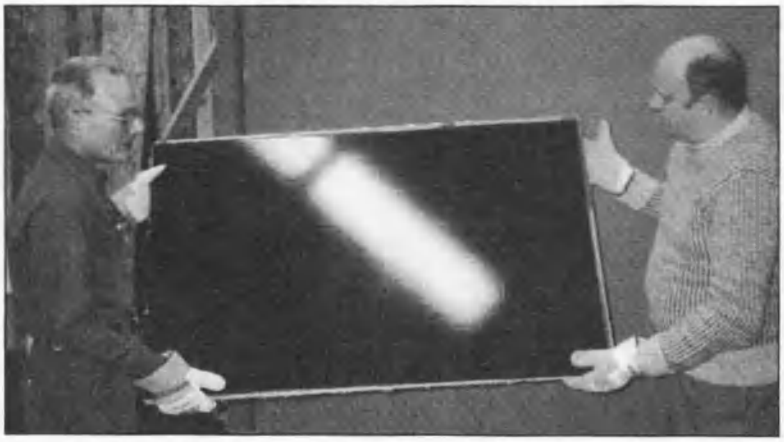


Photo A. AMSAT-NA V.P. Engineering Dick Jansson WD4FAB (L) and Executive V.P. Keith Baker KB1SF (R) inspect one of the flight model solar panels for amateur radio's newest and most advanced satellite. Working at the P3-D Lab at Weber State University in Ogden, Utah, the men display the Kapton electrical insulation layer. These panels, valued at more than $50,000, were donated to the project. (Photo by Ralph Butler, Weber State University.)

Photo B. Later, Jansson applied epoxy resin to the edge of one of the panels, which are constructed of 1/2" thick aluminum honeycomb material covered by a thin carbon composite facesheet. Each panel weighs only a few kilograms. (Photo by Keith Baker KB1SF.)

A Practical Weather Satellite Receiving System, Part 1

Set up your own weather satellite receiver/decoder.

by Angus Anderson ZR6UM

Weather satellites are the penniless technologist's dream come true. How else can an average person look onto the earth's surface from space?

I have been avidly interested in weather satellites for years now, but it took a series of articles by Dr Ralph Taggart WB8DQT in *73* magazine, as well as his excellent publication *The Weather Satellite Handbook,* to get me off my backside and do something about implementing a useable system. I have not been disappointed.

This begins our two-part series on home-building a weather satellite receiving system for Automatic Picture Transmissions (APT) from polar orbiting satellites, using a PC for display and picture storage. The system is flexible and, best of all, uses a sophisticated shareware software display package written by Eberhard Backeshoff DK8JV. This first part of the series will cover the receiver and APT demodulator, and next month the second part will cover the PC parallel interface and a review of the features of the JVFAX 6.0 software package.

We will not be able to cover the construction of a 137 MHz receiver or 1691 MHz down converter in these two articles. However, I gladly offer the kits for these items, with construction manuals, and details of other suppliers of receiving equipment are given below. The two parts of this article will cover decoder, interfaces, and display software only.

Like most hams who like to experiment with radios, I have had to learn the hard way about the pitfalls that await the unwary when setting up a weather satellite receiving and display system. Living at a QTH near the tip of Africa, access to information and specialized components can be difficult and expensive. This article will pass on some of my experiences in building the equipment.

Receiving Options

You really only have two options when receiving lower resolution weather satellite pictures directly from space. The first option is to set up a 137 MHz receiving system to receive and decode the pictures directly transmitted from polar orbiting satellites in the APT format. There are a number of these satellites in operation—at the time of this writing, the American NOAA 10, NOAA 12, NOAA 13 and NOAA 14 spacecraft are transmitting pictures. Also transmitting are the Russian METEOR (and sometimes

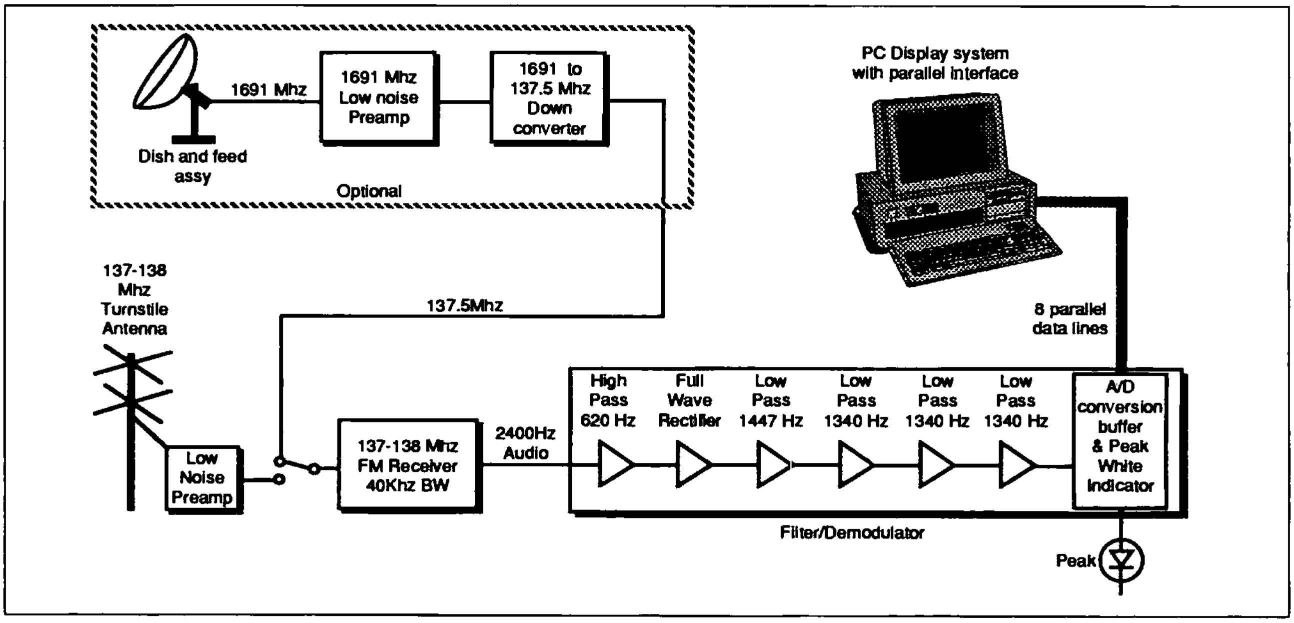


Figure 1. Block diagram of a typical weather 137 MHz satellite receiving system.

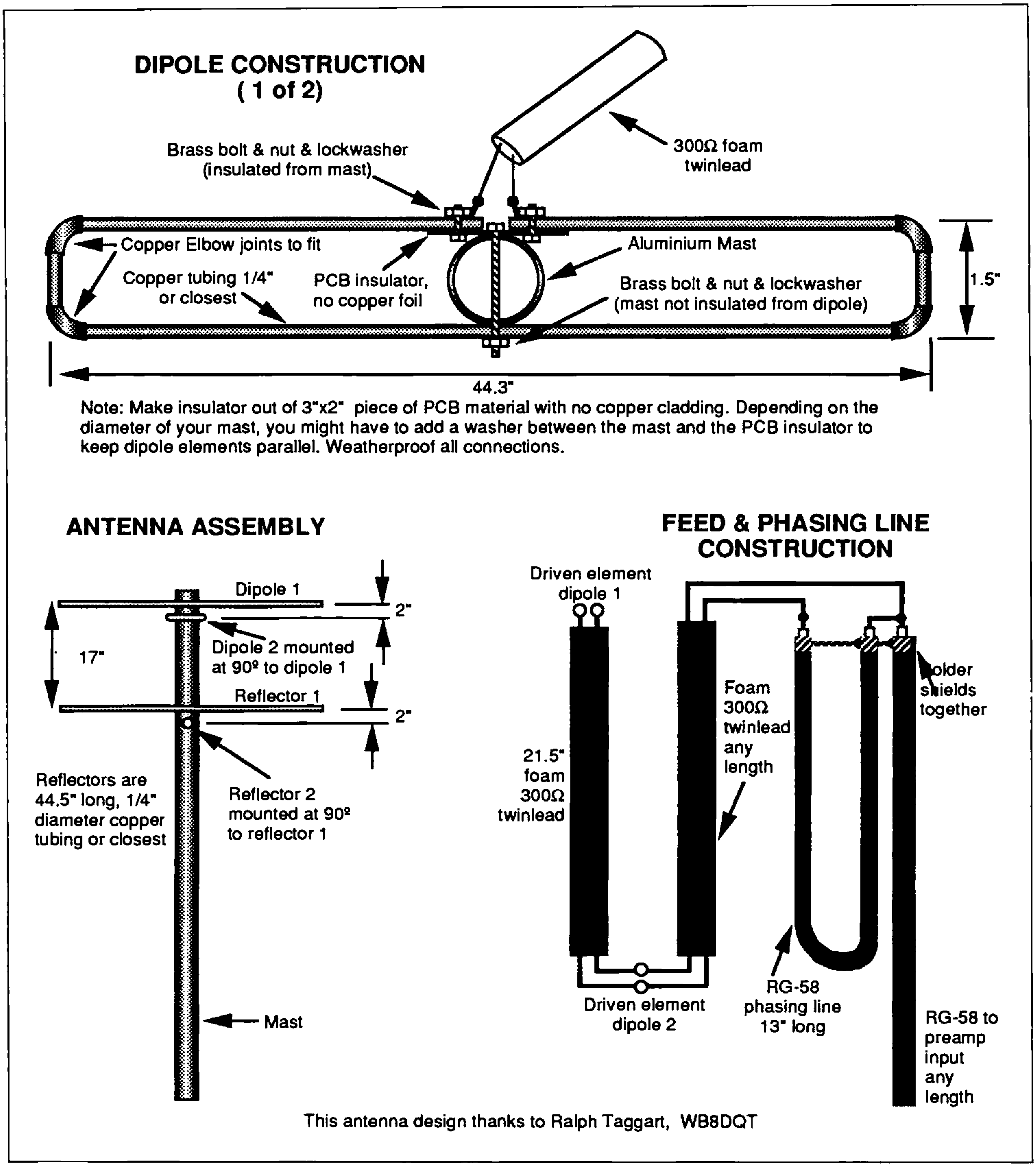


Figure 2. Turnstile antenna for receiving polar orbiting satellites.

COSMOS) satellites, which can provide spectacular pictures due to their strong signals and excellent visible picture resolution.

Polar orbiting weather satellites can give better resolution of geographical features than the geostationary satellites, due to their lower altitude. This can be a bonus on home-built equipment. Because their orbit is at about 950 km altitude (as opposed to the 35,000 km altitude of the geostatonary birds), you can usually resolve surface features better. The NOAA scanning radiometer optics correct for horizon distortion, yielding natural-looking pictures with a geometry that mostly looks like what you would expect to see on a map. This makes it easy to identify ground features from an atlas.

The second option is to implement an S-band receiving downconverter with a small dish or long yagi antenna to receive the geostationary GOES or METEOSAT transmissions. The S-band downconverter receives signals at 1691 MHz and converts this signal to 137.5 MHz—this can feed the input of your existing 137 MHz receiver. Transmission formats for both systems are similar, so the results of both can be displayed on your PC screen. Pictures from GOES or METEOSAT are not as detailed as the pictures from a polar orbiter (they can

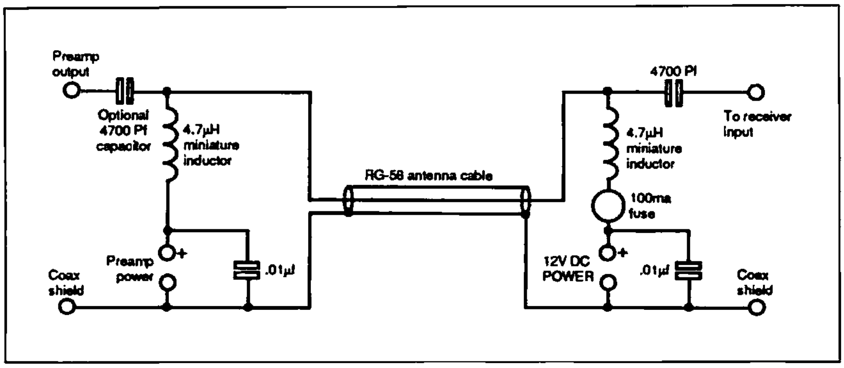


Figure 3. Feeding 12 VDC power to the preamp through the coax feed.

come close), but an added bonus is that the ground computers on the geostationary satellites add political boundaries and latitude and longitude marks to the picture, which makes it easier to orient yourself with an atlas.

For those of you who want to receive transmissions from the geostationary satellites, suitable equipment to implement a downconverter is advertised in the pages of *73* magazine. Some suppliers that I have seen are Spectrum International, Down East Microwave, and Quorum Communications.

Figure 1 shows a block diagram of a typical weather 137 MHz satellite receiving system, with an optional 1691 to 137.5 MHz downconverter. The downconverter feeds the input of a sensitive dual-conversion 137 MHz receiver with a 40 kHz IF bandwidth, and an FM demodulator for 1691 MHz signals, or is directly fed from the 137 MHz antenna through a low noise preamplifier for the polar orbiters. The demodulated signal at the output of the receiver consists of a 2400 Hz tone, which varies in amplitude with changes in brightness in the picture. The 2400 Hz tone is fed through a series of active filters, and is rectified to give a voltage which varies proportionally with picture brightness. This voltage is fed to an A/D converter, which converts the voltage to parallel 8-bit format at TTL levels. Each picture cell represents an 8-bit value (255 grayscales), and 800 or more cells (pixels) appear on the 8-bit parallel interface lines every quarter of a second! The 8-bit parallel TTL signal is routed to the PC display system via a parallel I/O interface in the PC.

The Antenna

Signals from all polar orbiting satellites exhibit changes of polarization and Doppler shift when being received by a ground station. This is because the spacecraft is moving fast with respect to the receiving station. Horizontally and vertically polarized antennas, such as those found in terrestrial installations, exhibit what is called linear polarization. NOAA satellites have Right Hand Circular Polarization (RHCP), where the polarization actually travels in a circular path as it moves through space. Using an antenna with linear polarization on NOAA spacecraft will present the user with deep, slow nulls of 20 dB or more in the received signal at the station as polarization changes. METEOR spacecraft, on the other hand, have linear polarization. With a circularly polarized receiving antenna of the correct sense, a linearly polarized signal such as is transmitted from METEOR spacecraft will show only some 3 dB loss, and NOAA signals can be received at full strength. While it is possible to build gain antennas with circular polarization and manual or automatic antenna tracking facilities, very good results can be obtained by building a simple crossed dipole with a reflector for each dipole, which is mounted facing vertically upwards. This antenna design is generally called a Turnstile. The Turnstile antenna, while being largely non-directional, will receive circularly polarized signals at full strength—exactly what we want. However, the lack of antenna gain on the turnstile will often make an antenna preamplifier necessary to receive noise-free pictures.

"My installation is proof that WB8DQT turns out designs that not only work well, but are repeatable in construction—mine went together with no trouble at all."

Figure 2 shows the details of a suitable turnstile antenna for receiving polar orbiting satellites. This design was taken from the *father* of cheap weather satellite reception, WB8DQT, and was originally called the *Satellite Zapper*. Apart from the use of copper plumbing tubing for the elements, the design is as the original. My installation is proof that WB8DQT turns out designs that not only work well, but are repeatable in construction—mine went together with no trouble at all. The diagram should give all the information necessary to implement a useable antenna.

With the addition of a suitable low-noise preamplifier mounted on the mast, I can get a full quieting signal on a good South-North pass at my QTH (30 km north of Johannesburg, South Africa) from the time the spacecraft rises to an elevation of 4 to 5 degrees above the horizon, to the time just before it sets. This equates to Prince Edward Island in the South Indian Ocean to Lake Victoria in Central Africa. A good S-N pass is one that rises to an elevation of 60 degrees or more above the horizon.

I used 1/2" copper tubing for all elements, available from plumbing shops. This was cut to length, and the folded part of the dipole formed by 90-degree copper elbows which fit over the tubing. The elements are soldered together with ordinary solder, using a 60-watt soldering iron, and form a rigid assembly. Let the solder flow right into the joints. Flatten the free ends of the dipole, and drill holes to accept the 300 ohm twin lead and the insulator which is made from a small piece of Fiberglas PCB material with the copper removed. This is fastened together by brass bolts, cable tags, and washers. The dipoles are fastened to the mast as shown, with the second dipole being 2" below the first, and at 90 degrees to it. The reflectors are mounted 17" below the dipoles by drilling a hole through the mast and fastening the reflectors to the mast with a suitable self-tapping screw. Your mast should be made of aluminium tubing, with the diameter about 1.25" or less. Drill the

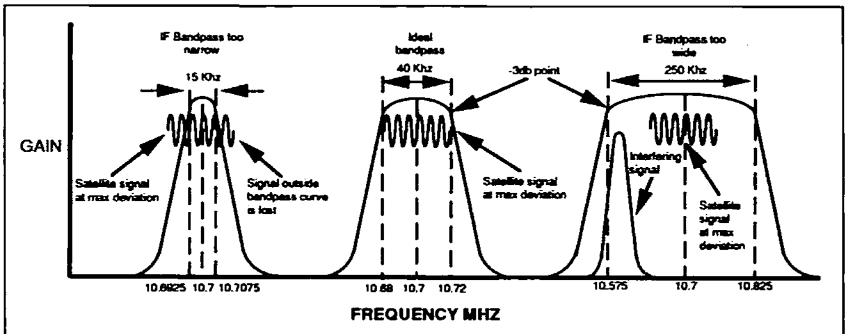


Figure 4. The ideal IF passband should have as flat a top as possible.

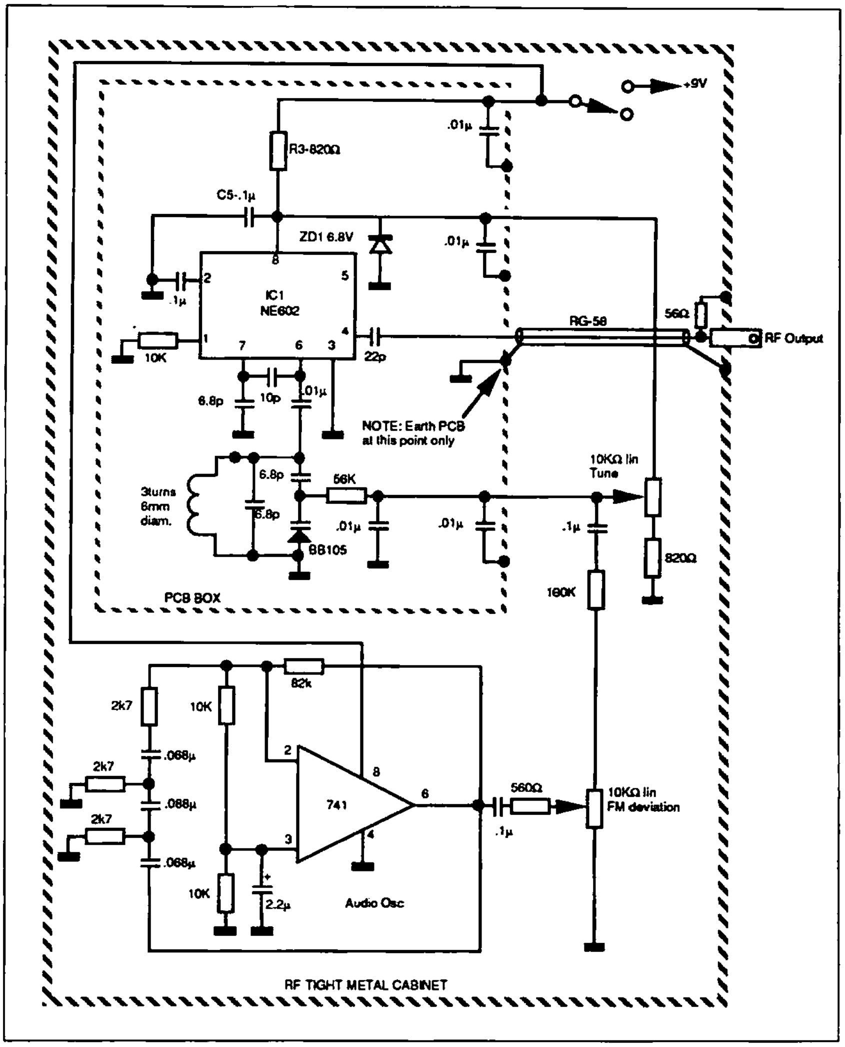


Figure 5. Circuit for a varicap-tuned FM signal source, based on the NE602 chip.

hole in the mast slightly larger than the one in the reflector element, which should be of the right size to accept the self-tapper. A quarter-wave delay line is made with RG58 coax, and soldered as shown.

When constructing the antenna, use good quality foam core 300 ohm twin lead and good quality RG-58 coax (don't go for bargain basement cable), and make sure that the preamplifier is adequately weatherproofed. Suitable mast mounting enclosures for the preamplifier are available from TV suppliers. Loop the cables to enter and exit at the bottom of the enclosure so that moisture drips off and does not creep in. Although it is possible to build your own preamplifier, really hot performers are available already built from a number of suppliers in the pages of *73* magazine. I like the Hamtronics LNA series GaAsFET units because in my opinion they provide unbeatable value for money, as well as having a 0.7 dB noise figure and lots of gain. They are also easy to retune from 144 MHz to 137.5 MHz without changing the noise figure, which was set to optimum at the factory. Since system performance is determined almost exclusively by the noise figure of the preamp, this is an important point. [Manufacturer's note: Hamtronics now offers the LNG-137 Series, $59, already tuned to WX SAT frequencies.]

The most convenient way to feed 12 VDC power to the preamp is through the coax feed. Figure 3 shows how this is achieved with the use of two inductors and some capacitors. Make sure that there is a blocking capacitor at the output of the receiver and the preamplifier. You can, of course, also use a separate wire to feed the DC, using the antenna coax shield as a return. Remember to fuse the feed with a 100 mA miniature fuse.

The Receiver

Your 137 MHz receiver should have an IF bandwidth of 40 kHz to receive decent pictures. Too narrow an IF bandwidth will not allow the full FM deviation (frequency swing) from the spacecraft to be accommodated in the passband, resulting in useless pictures, although the signal will be strong. Too wide an IF bandwidth will decrease receiver sensitivity and allow interfering signals to creep into the IF passband. Most scanning receivers that cover the 137 MHz band either have too narrow an IF bandwidth (NFM position is about 15 kHz) or too wide (WFM position is about 250 kHz). Optimizing your existing scanner would require changing some of the IF filters, not something for the faint of heart! I have been able to receive usable pictures with my AOR-2002 scanner set to the FM "wide" position, but only with a good preamplifier in line, and with a gain antenna. In other words, you will need lots of signal into the receiver if you use a wide passband. The optimum 40 kHz IF bandwidth will allow reception of full spacecraft deviation, as well as accommodating Doppler shift of about 6 kHz without having to retune during a pass. It also maximizes receiver gain and excludes interfering signals. Figure 4 illustrates the ideal IF pass band which should have as flat a top as possible. It also illustrates what happens when the IF passband is either too wide, or too narrow.

While some people have succeeded in modifying narrow or wideband FM receivers for a 40 kHz IF bandwidth, the best bet is either to buy a suitable receiver, or build your own from a kit. In the past, I have used the Vanguard FMR-250 receiver from

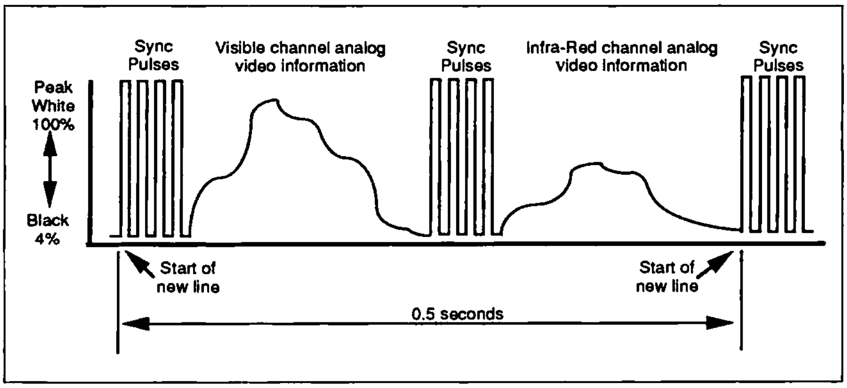


Figure 6. Simplified representation of a single APT scan line from NOAA spacecraft. Sync pulses appear as vertical bars down the picture, and are manually moved to the left-hand or right-hand side of the picture.

Figure 7. An example of Soviet METEOR imagery.

Vanguard Labs for 137 MHz band reception. This dual-conversion receiver is optimized for weather satellite reception. It is a crystal-controlled unit which I modified for variable frequency use by the addition of a home-built PLL-locked VFO. The results were great. The FMR-250 is now out-of-date, and has been replaced by the WEPIX 2000 synthesised receiver from Vanguard. Hamtronics also makes an excellently priced crystal-controlled 137 MHz weather satellite receiver kit, Model R137, priced at $129 at the time of writing. [Manufacturer's note: This model has been replaced by the R138, $99 kit—including built-in channels.] I presently use a home-built receiver, which is available from me either in kit form or built up. See below.

You have the option of either crystal control or a VFO. If you choose crystal control, don't forget to order crystals for 137.3, 137.4, 137.5, 137.62, and 137.85 MHz—this covers most of the polar orbiter frequencies. NOAA satellites transmit on 137.5 and 137.62. The most common Russian METEOR satellite frequencies are on 137.3, 137.4, and 137.85 MHz. Suitable crystals can be ordered from JAN Crystals (see their ad in *73*).

For those of you kit builders who do not have a suitable signal source for receiver alignment, Figure 5 shows a circuit for a varicap-tuned FM signal source based on the versatile NE602 chip. (I am preparing a further construction article using this circuit. Special attention has been paid in the article to shielding the RF output to obtain low level VHF signals.)

Decoding Weather Satellite Pictures

All low resolution APT weather satellite pictures have a similar transmission format. An FM carrier is modulated with an amplitude-modulated 2400 Hz subcarrier (tone). When the FM modulation is decoded, the instantaneous amplitude of the 2400 Hz receiver output represents the brightness of the picture cell (pixel) being transmitted. For an APT weather satellite transmission, time for a single scan line is usually 0.5 sec or 0.25 sec; that is, two or four lines per second, giving either 120 lines per minute (NOAA, METEOR), or 240 lines per minute (GOES, Meteosat, and some COSMOS satellites).

At 240 lines per minute, each 0.25 sec line scan represents the full width of the picture. On the 120 LPM NOAA polar orbiters, visible and infrared pictures are transmitted side by side. Thus a single scan line will start with visible picture information, followed by the same picture scanned in infrared. Figure 6 shows a simplified single line of weather satellite transmission from NOAA spacecraft. Note that there are two sets of phasing bars of seven lines each, as two pictures are transmitted side by side. It is these phasing signals, one alternating at 832 Hz and the other at 1040 Hz, that give the NOAA signals their unique "Tick-Tock" sound. The Russian METEOR spacecraft transmit one picture only, with a wide sync pulse train, and have a very different but distinctive screechy sound on the audio transmission channel. In practice, these bars appear as vertical stripes, and have to be moved to one side or the other to display the whole picture.

How many times the picture voltage is sampled per line by the A/D converter will give the number of pixels per line that are available for storage in your display device. The practical maximum for this is about 1024 pixels per line, giving a maximum sampling time per pixel of 0.25/1024, or 2405s per pixel on a 240 LPM signal. The A/D coverter free-runs at a much faster conversion rate of about 15s per pixel. This is easy for the software to handle. (See Figure 6.)

Figure 7 shows an example of Soviet METEOR imagery. This early morning S-N pass was received at 0500Z on 15th September, 1993, at my QTH. On the right is the western coast of Madagascar, with Cape St. Andre visible at the extreme top right. Opposite is the African coast of Mozambique, largely buried under cloud, with no features showing inland because the sun is not yet sufficiently high. One interesting aspect of this pass was that the satellite came above the horizon transmitting a black picture with only the sync pulses visible. Suddenly the picture burst into life as the light levels rose and the cameras switched on. The equipment used was the turnstile antenna, no preamp, a home-built 137 MHz receiver using the decoder, an interface and a JVFAX 6.0 running on a PC-386. The display was a 17S Trinitron Super VGA color monitor at 800x800 receive resolution. See further down in this article for how the picture was post-processed.

The Decoder

I chose to make a stand-alone decoder so that I could cross-couple inputs and outputs to a variety of receivers and display systems.

The idea is to take the amplitude-modulated 2400 Hz tone from the receiver, pass it through a set of bandpass filters to clean up the 2400 Hz signal, and then full-wave rectify this AC voltage to produce the varying (DC) voltage that represents picture brightness, with white being the highest voltage (5V), and black the lowest voltage (0V). This signal is then converted to parallel digital TTL form in an A/D converter, which presents a new pixel value at the 8-bit output

Continued on page 18

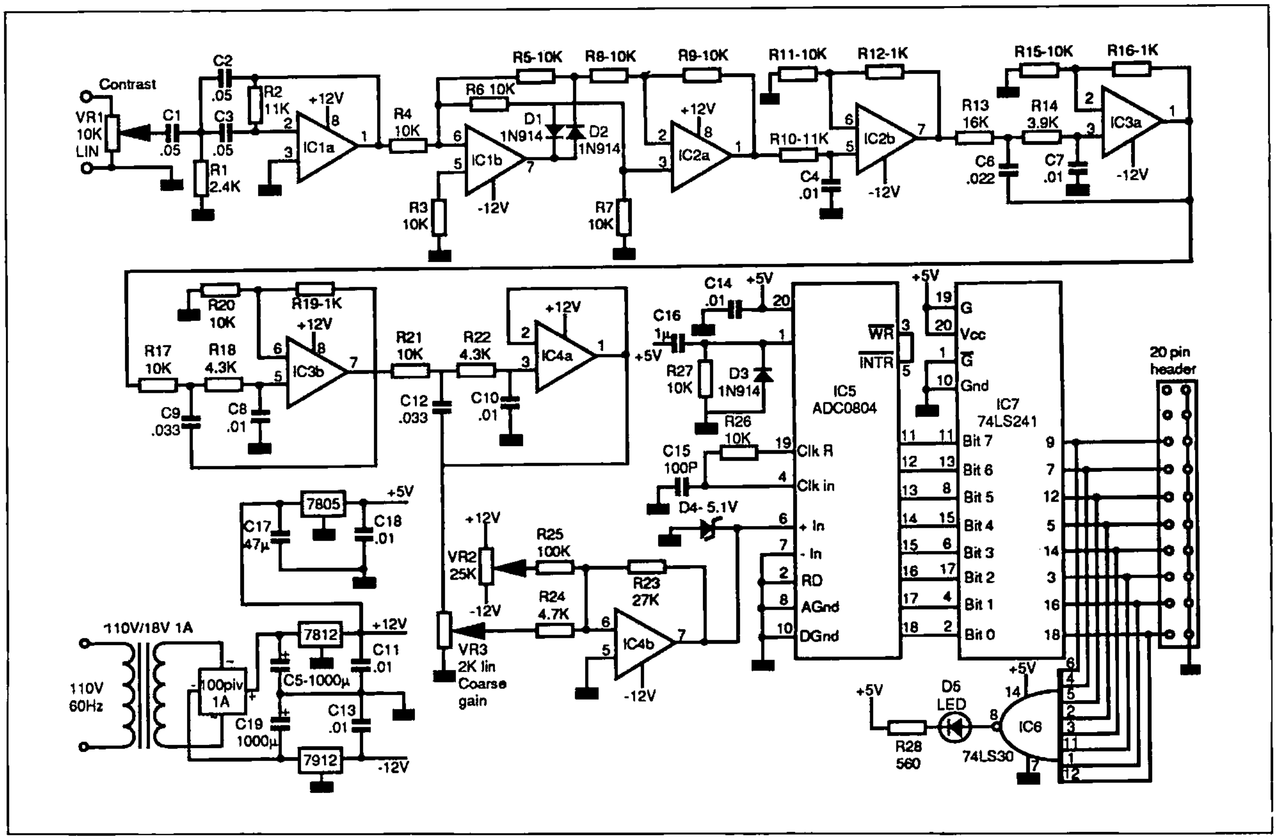


Figure 8. Filter/decoder board schematic.

lines approximately every 205s.

IC1a forms a high-pass filter at 620 Hz, which removes any undesirable 50 Hz and 100 Hz components from the signal, such as 50 or 60 Hz AC hum. IC1b forms an active full-wave rectifier, and is buffered by IC2a. The output of IC2a is fed to IC2b. IC2b, IC3a, IC3b, and IC4a are low-pass filters centered around 1340 Hz. The four 1340 Hz low-pass filter stages form a low-pass filter with an extremely steep high frequency rolloff. This is because it is necessary to remove the twice-2400 Hz (4800 Hz) component of the signal produced by the full-wave rectifier from the analog DC picture voltage. The voltage representing video brightness is then applied to a simple 8-bit analog-to-digital converter IC5, via U4b, where coarse video gain and the offset (black-to-white range) can be controlled by VR2 and VR3. Zener diode ZD1 clips the video at 5.1V max, which prevents possible damage to IC5. The internal conversion oscillator in IC5 is set to free-run at about 500 kHz, which produces a conversion every 205s or so. The output of the D/A is an 8-bit digital word which is placed onto eight parallel output lines through TTL buffer U6 at the A/D conversion rate. IC7 is an 8-bit NAND gate. When all eight parallel output lines from the D/A converter are at logic 1 (representing a video value of 255), the LED will light. This gives an excellent method of judging the peak white level. The LED should be adjusted so that it just flickers on video peaks. This parallel signal is then fed via ribbon cable to an 8-bit parallel I/O interface connected to the PC bus.

Power at 110V or 220V is supplied by a main transformer giving a secondary output voltage of 18 VAC, which feeds a full-wave rectifier feeding three monolithic regulators to provide +5V, +12V, and -12V. Make sure that you have the correct filter capacitor values. Clean DC and careful audio wiring will prevent 60 Hz hum bars from appearing on your pictures.

This decoder was based on a circuit design by A&A Engineering (see "Finding Out More"), with some changes. I understand that a kit is still available from them. Details below.

Building the Decoder Board

See Figures 8 and 9. The decoder board consists of a single-sided PC board. Note that foil traces are shown in what is known as the X-RAYS view, as if you are looking through the board. View the board from the component side. Insert and solder the wire links first. Then mount the IC sockets, being careful to orient them correctly—the socket notch is in line with pin 1 of the IC. This will aid your orientation during the next step, which is inserting and soldering the resistors. Note that some resistors have to be paralled to achieve non-standard values; the Parts List shows which. Insert and solder the filter capacitors, starting at the board area around IC1, and ending at the area around IC4. Then solder the electrolytics, being careful with the orientation of polarity. This is especially true of the tantalum capacitors, whose polarity is difficult to establish at the best of times, especially with my aging eyes! Because the whole performance of your filter system depends on correct resistor and capacitor values, double-check these components before proceeding. Next, insert and solder the 1N914 diodes, the power supply diodes or bridge, and the 5.1V zener diode. Mount the three regulator chips standing up. Current draw is such that they do not need heat-sinking. Then mount the PCB connection pins to the output lines. Mount the preset pots, and wire the audio level pot VR1, and the peak video LED. DO NOT install the chips yet.

Do an ohmmeter check of the +12V, -12V, and +5V power rails to establish if there are any shorts. Wire up the power transformer, and set VR1 to min, VR2 to max, and VR3 to mid-range. Power up the board, and check that the correct DC voltages are present at the +12, +5, and -12V pins on all the sockets. Switch off your power.

Insert all chips into their sockets. Switch the power on again. Voltage at the output pins of all the 1458 ICUs (pins 1 or 7)

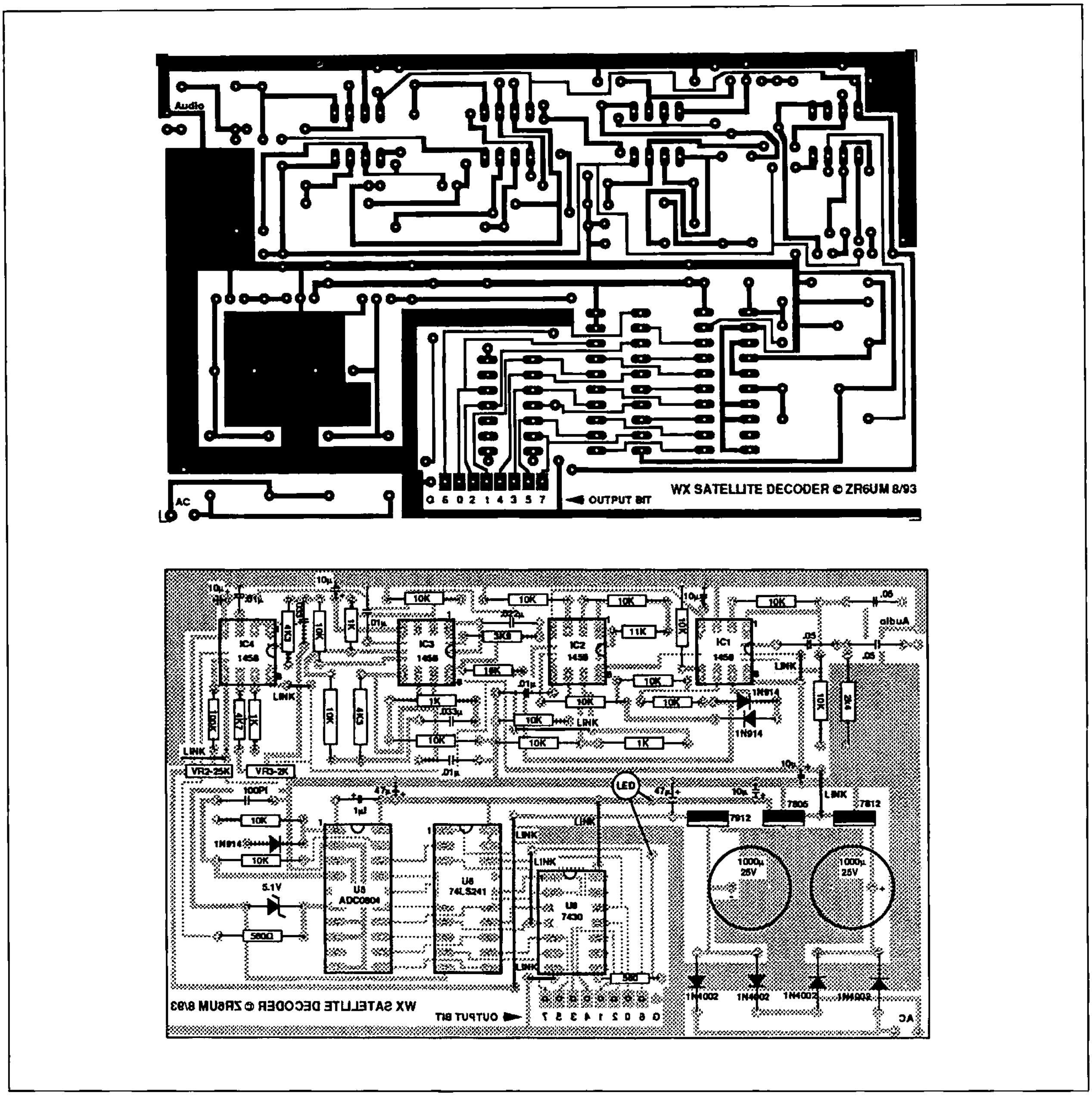


Figure 9. a) Decoder board 1:1 PCB layout. b) Decoder board parts overlay.

should be at or very close to zero, with reference to ground. If this is not so, check the circuit from the first stage to the last to establish which stage has a problem. Remember that all these 1458 stages are DC-coupled, so a wrong voltage on one op-amp output pin will affect all the other stages down the line.

Testing the Decoder

Set VR2 to mid-range, and VR3 to maximum. Feed a stable 2400 Hz sine (preferably) wave source into the input at about 1V P/P, and advance contrast control VR1. If you do not have a source of 2400 Hz signal handy, use a passing satellite signal. Some-

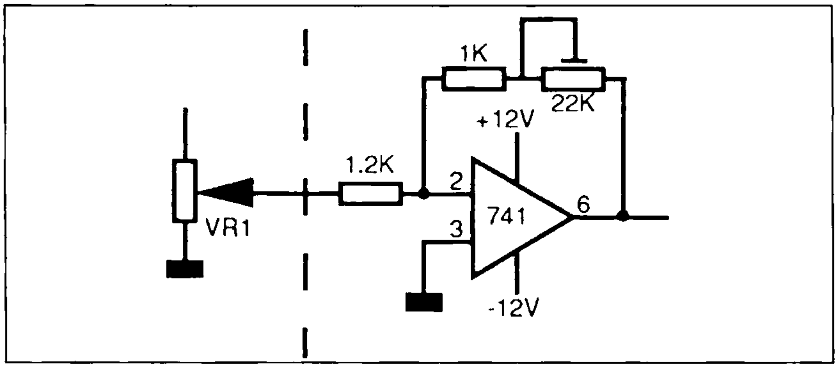


Figure 10. Circuit for a simple audio amplifier stage.

where toward the end of VR1Us travel, the LED should flicker. If this is happens, you have a working system, and all that remains is adjustment. If it does not, use an oscilloscope to check the outputs of IC2, IC3, and IC4. These should vary in DC voltage when you vary VR1. If you get variation at pin 6 of IC5, your filter system (ICUs 1 to 4) is most likely working. Check with a scope that IC5 is oscillating at about 500 kHz (pins 4 and 19 of IC 5). If you still do not get an LED indication, check that the max DC voltage at pin 6 of IC5 is close to 5V with VR1 near max. Adjust VR1, VR2 (offset) and VR3 (coarse gain) to achieve this. I have come across some ADC0804Us that latch up on power on; this could be your problem. Set VR1 so that the DC voltage at pin 6 of IC5 is 5V, and then switch the power on and off a couple of times. If the LED comes on, check that it goes off when you decrease VR1, and comes on again when you increase VR1. If this is the case, you have nothing wrong except a latching A/D converter. I choose to live with this problem. Sometimes I switch power on and off a couple of times when starting up until I get a flickering satellite signal LED, then all is well! Remember to have a 2400 Hz peak level signal present at the input when switching on. If you still do not get a signal, check with a scope that there are TTL signals at the output pins of IC5, and also at the output pins of IC7. You should finally adjust VR1, VR2, and VR3 to get about 0.3V for black level, and about 5V for white level on a live satellite signal at the input of the A/D converter. A scope is useful here.

One final point on the decoder: Although I have not tried it, the decoder PCB is small enough so that it can piggyback on the parallel interface board inside the PC, using standoffs. You will then save all the power supply components needed for a stand-alone decoder because you will be able to use the PC power supply voltages to power the decoder. You will, however, need to lead the LED indicator out to the front panel, and the input level control can also be remotely mounted. If you are going to use this option, remember to mount the offset and gain set preset pots at right angles to the PCB, so that they face upward and are adjustable when the boards are mounted in a PC slot.

Parts List

R1	2.4kΩ (2.2kΩ & 220Ω in series)
R2,R10	11kΩ (10kΩ & 1kΩ in series)
R3,R4,R5,R6,R7,R8,R9	10kΩ
R11,R15,R17,R20,R21,R26,R27	10kΩ
R12,R16,R19	1kΩ
R13	16kΩ (15kΩ & 1kΩ in series)
R14	3.9kΩ
R18,R22	4.3Ω (3.9kΩ & 390Ω in series)
R23	27kΩ
R24	4.7kΩ
R25	100kΩ
R28	560Ω
VR1	10kΩ log (contrast)
VR2	25kΩ lin preset (A/D level)
VR3	2kΩ lin preset (coarse gain)
C1,C2,C3	0.05 µF
C4,C7,C8,C10,C11,C13,C14,C18	0.01 µF
C5,C19	1,000 µF 25V electrolytic
C6	0.022 µF
C9,C12	0.033 µF
C15	100 pF
C16	1 µF tant.
C17	47 µF 16V tant.
D1,D2,D3	1N914
D4	5.1V zener, 400 mW
IC1,IC2,IC3,IC4	MC1458 or LF353
IC5	ADC0804
IC6	7430
1C7	74LS241

All resistors are 1/4 watt, 5% tolerance or better.
Tantalums are miniature bead type.
Other non-electrolytic caps are disc ceramic type, 16V or higher. Try to purchase or select these capacitors to 5% tolerance.

Decoder Power Supply
100 PIV 1 amp diode bridge
110V/18V 1 amp mains transformer
7812 monolithic +12V regulator, TO-220
7912 monolithic -12V regulator, TO-220
7805 monolithic +5V regulator, TO-220
Note: For safety, insert a lamp fuse and suitable holder in the live leg of the mains supply.

Miscellaneous
4 x 8 pin DTL sockets
2 x 20 pin DTL sockets
1 x 14 pin DTL socket
Red LED & panel mounting plastic collar
PCB Vero solder pins x 9
Stranded insulated hookup wire
Tinned copper wire
PC board

Connecting the Decoder to your Receiver

You should connect the decoder directly off a tap led from the top of the volume control in your receiver. If you do not have enough gain from your receiver audio, Figure 10 gives the circuit for a simple audio amplifier stage, which may be simply built using perf board. Put this between VR1 and the decoder.

Summary

At this point, we have created the receiving path which starts with a satellite signal, and ends with the 8-bit parallel TTL A/D signal suitable for feeding to a PC based display system. Next month we will cover the PC I/O interface card, and the installation and use of JVFAX 6.0 display software.

Finding Out More

The *Weather Satellite Handbook*, written by Ralph Taggart WB8DQT, is available from the Uncle Wayne's Bookshelf. This contains almost everything that you might ever want to know about setting up a weather satellite station. Another good source of knowledge is the Dallas Remote Imaging Group (DRIG) bulletin board at (214) 394-7438.

A full kit of parts for the decoder with power supply (excluding cabinet) can be obtained for $55, or fully-built and tested for $95, from the author. Air postage to US, Canada, and Europe paid; other destinations on request. (Angus Anderson, P.O. Box 41544, Craighall, 2024, South Africa; Tel.: Business hours, country code 27, city code 11, 468-1106; Fax: country code 27, city code 11, 468-1034; CompuServe: 70262,1702. I accept Visa, MasterCard, cash, or money orders. No cheques please. South Africa is nine hours behind PDT, six hours behind EDT, and two hours behind GMT.)

A high performance weather satellite receiver kit with PLL-locked VFO tuning 136 MHz to 138 MHz (excluding cabinet, P/S, and tuning mechanism) can be ordered for $185.

The decoder board can also be obtained from A&A Engineering, 2521 West La Palma #K, Anaheim, CA 92801. Tel 714-952-2114. Prices on request.

A PLL-controlled VFO kit only for a 10.7 MHz Rx IF can be ordered for $95 from the author. This contains all parts, crystals, and the PCB, but no cabinet.

HF-SAT Antenna

An easy-to-build dual-band HF satellite antenna.

by Edward Oros AC3L

Here is an antenna for the nineties. It's strong, computer designed, and has lots of gain.

This is a no compromise dual-band antenna. Instead of using traps, this design interlaces two separate antennas (the 10 meter band and the 15 meter band) on one boom. This is a full-size, four-element beam on 10, and three elements on 15 meters!

The design uses large 1"-diameter aluminum tubing to keep ohmic losses to a minimum, to survive heavy winds and withstand ice build-ups in the winter.

Since it is both a 10 and 15 meter antenna, it is the perfect antenna for anyone interested in working the RS satellites which have uplinks on 15 and downlinks on the 10 meter band.

The HF-SAT produces plenty of gain on both bands. The antenna was computer optimized for maximum forward gain (hence the low front-to-back). The 10 meter band has close to 9 dBd gain (free space), and the 15 meter band produces over 7 dBd (also free space). (See the sidebar.)

Photo A. The finished HF-SAT Antenna in service. (Photo by N3LSS.)

Construction

Since all elements are of 1" tubing, it's just a matter of laying out each element end-to-end and cutting the last piece to the required length for that element. Each 1" section is joined to the next piece via a third piece of aluminum (0.875" diameter) which slides into the 1" sections (see Figure 1). Drill holes on either side of the joint and use bolts to secure each section in place. The elements are attached to the boom by muffler clamps.

Feeding

Current baluns should be used at each feed point. They can be commercial models, or just loop several turns of the cable to create your own balun. Separate cables are run to each feed point and then run to a mast-mounted switch box or straight into the shack. You can choose you own favorite matching method but in this case a gamma match was used at each feed point, and this worked well. If the antenna is mounted at 40 feet, the 10 meter antenna should have an impedance near 13 ohms.

The 15 meter antenna is around 27 ohms. If you'd like, you could just use a two-to-one (2:1, 50-25 ohms) balun to match the 15 meter antenna, and skip the gamma match here. Figure 2 and Table 1 show all of the necessary measurements for the beam.

Test Out

The initial tests of this antenna were per-

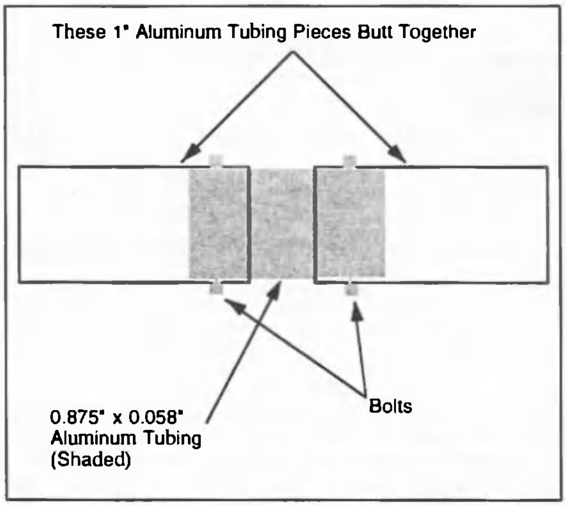


Figure 1. Construction detail for joining the 1" tubing sections.

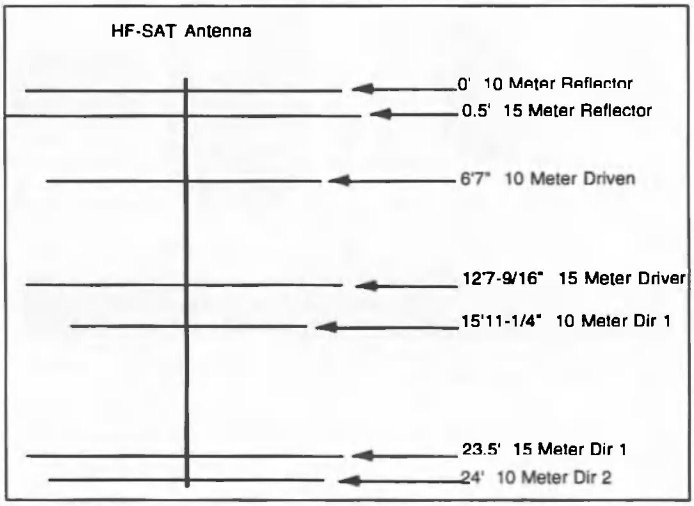


Figure 2. Construction measurements for the HF-SAT Antenna. Dimensions shown indicate element positions on the beam.

Gain Figures for the HF-SAT Antenna

10 Meter Band: Free Space	10 Meter Band: Above Ground (40') Max Gain @ 12 Deg	15 Meter Band: Free Space	15 Meter Band: Above Ground (40') Max Gain @ 15 Deg
Gain 8.92 dBd	13.82 dBd	7.36 dBd	12.22 dBd
F/B 12.47 dB	12.08 dB	7.13 dBd	6.86 dB
Imped. 13.1+ j 2.1	12.8 + j 1.4	27.40 + j 1.5	27.00 + j 1.3

Table 1. Element Lengths

Reflector	16' 10-13/16"	22' 2-1/4"
Driven	15' 10-9/16"	21' 1-3/4"
Director 1	15' 9-9/16"	20' 11-5/8"
Director 2	16' 6-1/2"	N/A

formed while on a 10-foot pole. The comparison antenna was a three-element, 10 meter monobander created using standard beam formulas and was not computer designed. Local tests showed that the HFSAT antenna was already slightly better signal-wise than the 40-foot-high three-element beam. Once the HF-SAT antenna was taken up to the 40-foot height it proved to be 10 dB stronger than the original casually-designed antenna—an impressive and worthwhile increase in gain, to say the least. The antenna has been excellent on both bands.

Number 6 on your Feedback card

Grounding and Lightning Protection, Part 2

Effective RF grounding for the shack.

by Glen E. Zook W5UOJ

The first part of this article, which appeared in last month's edition, covered information about lightning and lightning protection for the amateur radio station. This month we'll continue with information and suggestions about RF grounding.

Grounding for radio frequency protection is different from that required for lightning protection. The lower the frequency of the amateur radio transmitter, the easier it is to get a good ground. Because the wavelength gets shorter as the frequency increases, the possibility of hitting "hot" spots on the ground system increases dramatically. Thus, on frequencies above 6 meters, a true ground is, for all practical purposes, impossible to achieve.

In this installment we will describe a good RF ground system for 160 through 6 meters. It will help on 2 meters and above, but, as stated before, achieving a truly good ground on those frequencies is extremely difficult.

First of all, it is imperative that the ground wire be kept as short as possible. In the case of the ground at W5UOJ, it is less than four feet long! Use of stranded #6 wire or heavier copper is strongly recommended. If your station is installed above the ground story of a building, special techniques must be employed to achieve a good ground. Those grounding techniques are beyond the scope of this article. However, many of the tips outlined herein will still apply.

A very low impedance ground system is necessary to prevent all sorts of ills in the RF world. Things such as TVI, BCI, etc., can be greatly reduced and even eliminated when a proper ground system is employed. Because of this, I strongly suggest that you use a large surface ground within the ham shack. Aluminum flashing, available from handyman centers in varying widths, is excellent.

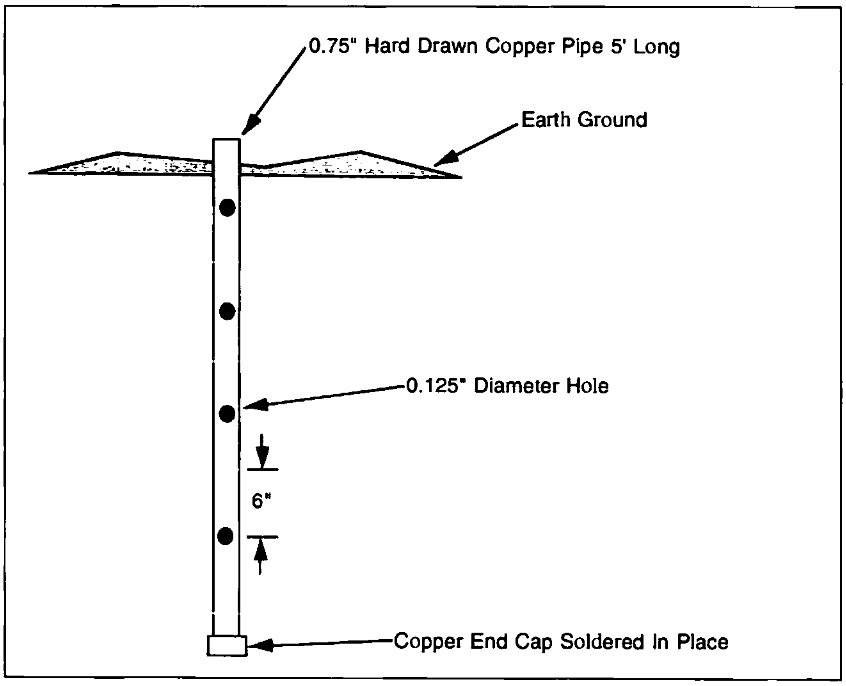


Figure 1. Diagram of the chemical ground rod. Fill it with rock salt (calcium chloride) after driving it into the ground.

This flashing can be placed on the tabletop or under the equipment, or mounted on the wall behind the operating center. W5UOJ uses the latter method. Since the operating console is two-layered, two separate runs of flashing are placed along the wall behind the console. A third piece of flashing runs between the two, making a horizontal "H." The three picces are bolted together in several places with #8 bolts.

Grounds to each piece of equipment (and I do mean each piece of equipment) are made with short pieces of braid. Although available as just braid from various sources, it is usually cheaper to remove the braid from old RG58/U coax. Just cut the coax a few inches longer than desired, remove the outer jacket, and then pull the center conductor from the braid. Flatten the braid and either attach it directly to the equipment or add a solder lug and then attach. Connect the other end to the aluminum flashing using #8 bolts. Put the heads on the back side of the flashing and then put a nut on the front side. A second nut with two washers is used to attach the ground braid.

Grounding each and every piece of equipment means that you must ground rotor control boxes, keyers, table lamps (if made of metal), antenna switch boxes, oscilloscopes, etc., in addition to the usual grounding of the receiver, transmitter, linear amplifier, antenna tuner, and the like. Even the low-pass filter (You do use one?) should be grounded separately from the transmitter or linear amplifier. Speaking of linear amplifiers: Use a low-pass filter between the exciter and the amplifier, as well as between the amplifier and the antenna, grounding it as well. This helps limit the possibility of TVI by several factors.

Outside the building there are several possibilities for making the ground connection. The simplest, and not necessarily the best, is a 6- to 8-foot rod driven into the ground. Depending on the soil conductivity, this may or may not be a good ground. Of course, amateurs living in extremely rocky conditions have special considerations, which will not be outlined here because they represent a completely different set of problems.

A relatively cheap but very effective

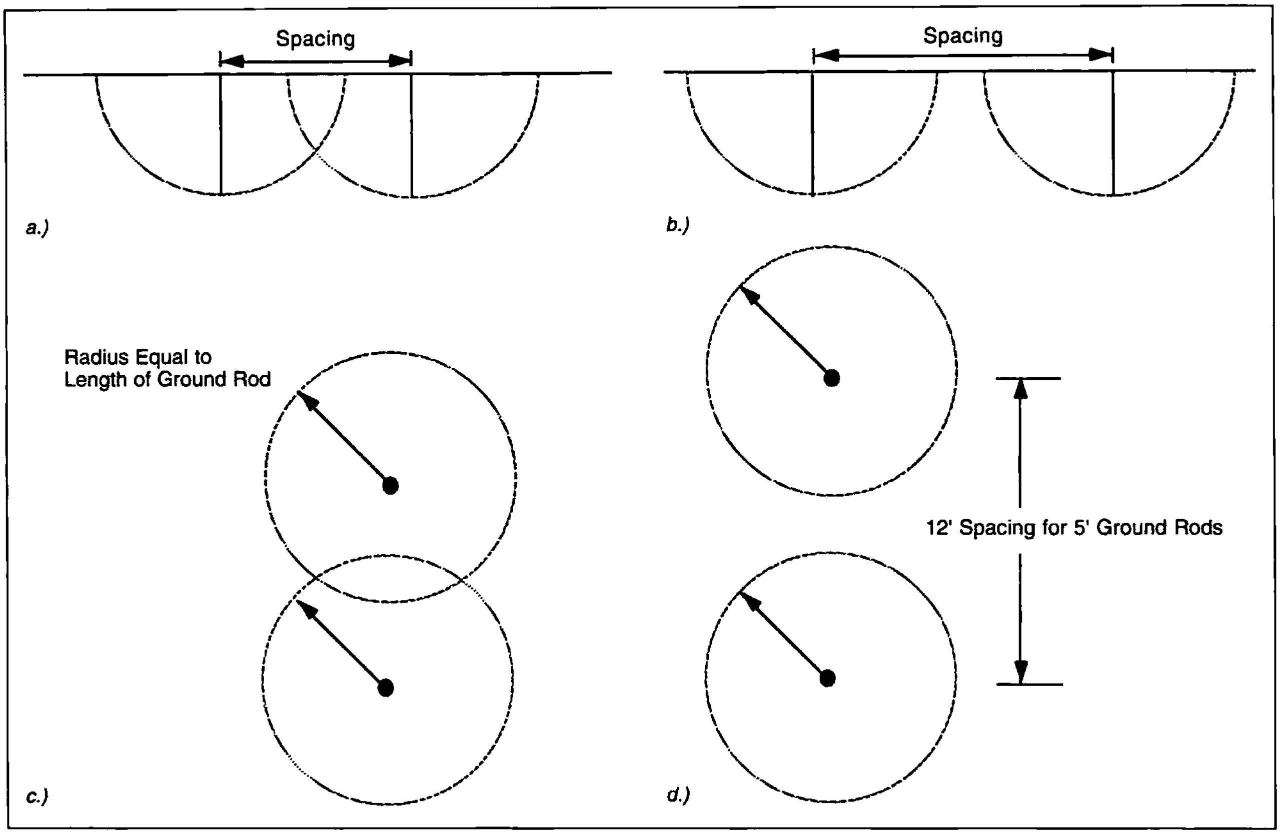


Figure 2.a) Horizontal view of overlapping hemispheres of grounding. The effects are not as good as when the hemispheres are not quite touching. b) When installing two or more ground rods, the spacing should be approximately 2.4 times the length of the rods. For a 5-foot ground rod, the proper spacing is around 12 feet. c) Vertical view of overlapping hemispheres. d) Vertical view of proper spacing of the ground rods.

ground system can be constructed from hard-drawn copper pipe. Sections of this material are available from handyman centers in 10-foot lengths. By cutting the lengths in half, two 5-foot rods are available. It would seem that one 10-foot rod would be better than two 5-foot rods, but this is usually not the case. Installing two 5-foot rods 12 feet apart makes a much better ground system than if a single 10-foot rod were used.

Actually, the copper pipe is made into a very effective chemical ground system by the addition of one 39-cent item and drilling a few holes! See Figure 1. By soldering a pipe cap on the end of 0.75" (3/4") pipe and then drilling 0.125" (1/8") holes every 6" from the capped end, the potential for a chemical ground is achieved. Rotate the drilling 90 degrees each time, going all the way through the pipe. Then, drive the first pipe into the ground (with the capped end going into the ground). After driving, the end of the pipe will be flared, but this causes no problems. Don't use water to help wash the pipe into the ground. This will cause problems with the chemicals added later.

Next, drive the other ground 12 feet away. If you want, you can construct other ground rods and place them 12 feet away from any other ground rods (in whatever direction desired). Then, attach at least #12 (or larger diameter) wire between the ground rods. Attach the ground wire coming from the shack to the rod nearest the shack. Next, fill the pipes with rock salt (often sold in grocery stores as ice cream salt). This is calcium chloride, and will not hurt the environment as will copper sulfate or other chemicals.

Do not wet the area around the ground rods. The natural moisture in the ground will slowly dissolve the salt and increase the ground conductivity immensely. After about a month, refill the pipes with rock salt. Then, every six months refill again. The rock salt costs less than $2 a bag, and a bag will last several years.

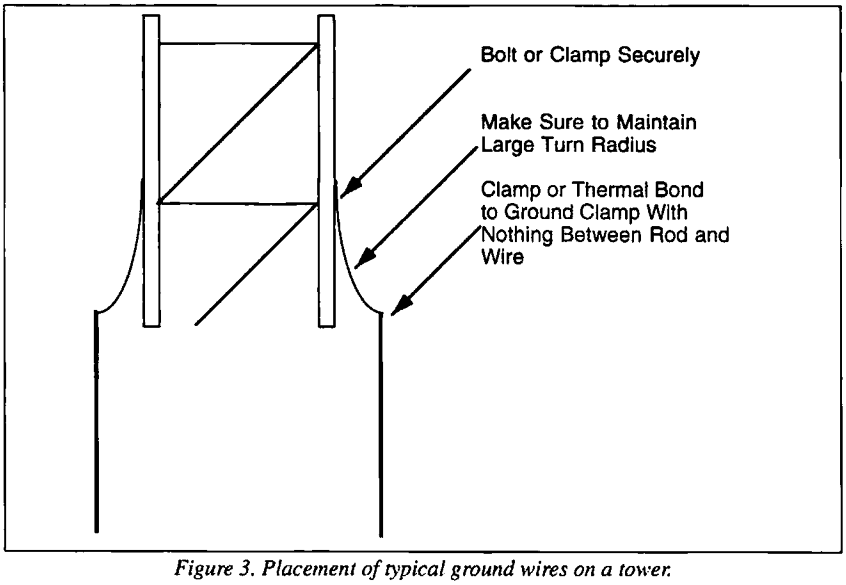


Figure 3. Placement of typical ground wires on a tower.

You can buy commercial ground rods which do this job. However, they cost well over $100 each! By building your own, you cut the price to less than $10 per ground rod!

There is a definite reason for placing the ground rods 12 feet apart: The hemisphere of grounding which takes place around each ground rod (see Figure 2). Basically, you want the hemispheres to not quite overlap, but not be too far apart. Thus, 12 feet works out to be virtually optimum with 5-foot ground rods. If you use ground rods of a different length from 5 feet, place them 2.4 times the length apart.

Place chemical grounds at the base of vertical antennas to get the best ground possible. Then, attach radials to the connection between the coax shield and the ground rod. Again, the placement of two or more chemical ground rods will help the performance of the vertical.

In this area, the cost of a 10-foot section of hard-drawn copper pipe (use the more expensive type since it is much harder and drives into the ground easier) was $8.40. The cost of the end caps was $0.39 each, and a ground clamp cost $2.15. These were purchased at a local handyman center. This makes a total cost of $13.48 (plus tax), or $6.74 per ground rod. The rock salt ("ice cream salt") was $1.39 for a 10-pound bag.

Power Line Grounds

A number of years ago there was a president of a major electric company who also happened to be an amateur radio operator. Over a very short period of time he began to have all sorts of problems with TVI, HiFi I, BCI, telephone I, etc. After exhausting all other sources, the author was called in. It only took a couple of minutes to discover the problem, for the president was relying on his own power company's ground! Needless to say, the very next day there were no less than three power company crews present at his house making the necessary changes to the ground system.

Remember, never rely on any ground that has been provided by the power company, telephone company, or other utility company. Never rely on a ground made to a cold water pipe for, even if your system is a complete soldered copper tubing or copper pipe system, it will still probably be a poor ground since the outside waterpipe is usually something other than copper. In houses with metal pipes other than copper, the pipe joint compound used in making connections is a very good insulator!

It is a good idea to connect these systems to the ground system, but never rely on a water system for a ground. Besides, many houses these days use PVC piping, which is an excellent insulator. Stay away from gas pipes at all costs! You don't want problems.

If you have a chain link fence, include it in the counterpoise system by connecting it to your ground system. If you are running a vertical, the inclusion of the chain link fence will almost certainly improve the performance of that antenna. But, in all cases, make sure to ground the fence to your primary ground system.

There are all sorts of hints which apply to ground systems. However, by following the guidelines outlined herein, you gain a good ground for your RF. A little work on the front end can save much grief in the long run. I am a firm believer in the practices outlined in this article! Yes, there are probably other methods which can be utilized in grounding, but those outlined here have proven their usefulness. Try them, you won't be disappointed!

73 Review

Number 7 on your Feedback card

by Steve Katz WB2WIK/6

Azden Corporation
147 New Park Road
Franklin Square NY 11010
Telephone: (516) 328-7501; Fax (516) 328-7506
Price Class: $409

The Azden PCS-7200

A solid 222 MHz Mobile FM transceiver.

The Azden PCS-7200 may be a little-known entity, but it is alive and well and putting out good signals on 135 cm FM around the country, and likely elsewhere. Azden is not one of the "big three" Japanese ham equipment manufacturers, and they don't make HF-SSB equipment. But like Alinco, they make some very usable VHF-FM gear that should not be overlooked when it is time to go shopping for that new rig.

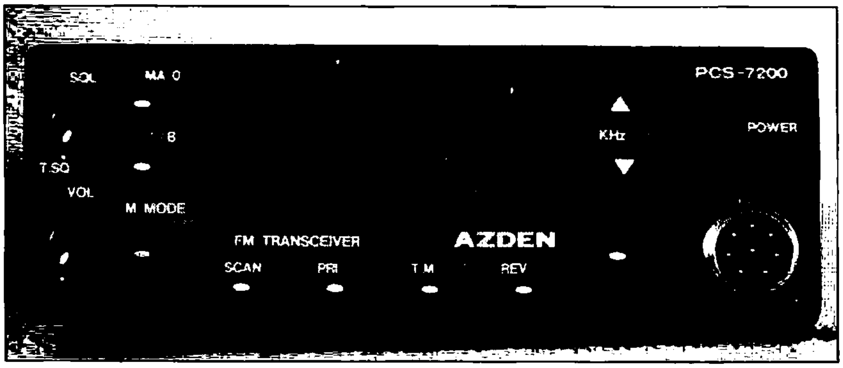
Azden's "claim to fame," so to speak, is that they manufacture budget-priced mobile and portable transceivers for 50 and 28 MHz FM. Although Azden has been around selling 2 meter rigs for 19 years now, they have little competition in the 6 and 10 meter arena, which most manufacturers have chosen to almost ignore. But Azden also makes high-quality FM rigs for 144, 222 and 440 MHz, and the PCS-7200 is one of only two 135 cm FM mobile monoband transceivers currently on the market.

I don't know how things are where you live, but here in Southern California 135 cm is almost as popular as 2 meters. There is considerable simplex activity and a great number of high-level 222 MHz repeaters occupy every single available channel on the band. Many of these "machines" offer autopatch, almost unheard of on 2 meters in densely-populated areas; and coverage on 135 cm is almost exactly the same as it is on 146 MHz. This is the only popular amateur band in the U.S. where every class of licensee has voice privileges, and Novices cut their teeth on "phone" daily by making contacts on 222 MHz.

The Azden PCS-7200 is an excellent entry-level radio for newcomers and old-timers alike. With 25 watts output power and a sensitive, selective receiver, it's a "workhorse" radio that will serve a variety of needs from simplex to repeater, to autopatch, to packet work. It's a pretty radio, like the other Azden mobiles, and is a pleasure to just look at, with its deep orange-backlit LCD display and orange-illuminated microphone pad buttons.

"I don't know how things are where you live, but here in Southern California 135 cm is almost as popular as 2 meters."

The PCS-7200 comes factory-equipped with a PTT/DTMF ("TouchTone") microphone, mike hanger, DC power cord and spare fuse, mobile mounting bracket and hardware, and owner's manual with schematic diagrams. Like most Japanese gear, the Azden does not come with any real service information, but Azden does offer a two-year limited warranty, where all repair costs are borne by the company for the first year and the cost of replacement parts (but not labor) are covered for the second year.



Initial Use and Programming

There are a couple of downsides to the Azden. One: The documentation is a bit lacking. The PCS-7200 does not have its own instruction manual, but uses the PCS-7000 (2 meter rig) manual, with an "Addendum" sheet to clarify the differences. The PCS-7000 manual has typographical errors and other mistakes, and using it with an "Addendum" sheet means referring back and forth between two papers to get things right.

Secondly, the Azden is not particularly "user friendly," and requires real study of the instruction manual. Probably the most important thing to know for FMers is how to program a transceiver's memories with frequency, offset and tone data. The Azden is surely programmable, and has 20 memories which do store all the important data—but the Instruction manual uses a page and a half of text describing how to do it, and until you've programmed the radio a few times, it's a nearly incomprehensible task. As I've said in other product reviews, I rate new equipment for "user friendliness" based on whether I can figure out how to do everything required without ever referring to the instructions. With the PCS-7200, to program each memory you must push the PROG(WR) key six times, and make other keystroke entries as well. It's a task that only Superman could accomplish while driving the freeway, although I'll admit that once I had programmed the first few, the rest of the memory channel programming went quite well (at home, on the bench).

Like the PCS-7500H 6 meter rig, the PCS-7200 defaults to memory "A0" (the first of its possible 20 memory channels) on power-up and does not remember where it was last used. This can take a bit of getting used to, if you're accustomed to other popular brands of FM gear. Also like its 6 meter brother, the 7200's memory storage is only accomplished by turning the radio off at the end of the programming sequence. The following NOTE appears in the manual: "Be sure to turn off the power when you have completed programming. This procedure is required to get each setting programmed in and then to get

out of the programming mode." Weird, but it works.

The PCS-7200 is able to program any frequency offset ("split") on every single memory channel, which is a plus in my book. (Although all our local repeaters here use a minus 1.6 MHz offset, anyway. But that could always change, and it might be different elsewhere.) However, because the Azden lacks any preconceived "offset" of any kind, when programming for use, one must enter both the transmit and receive frequency for every single channel intended. This is quite different from other FM mobile rigs on the market, and takes a bit more time to accomplish. This isn't a big deal if you do all your programming at home and then intend to keep the memory channels as they are for a long time, but it could be an inconvenience for those who fiddle around a lot and like to change memories daily.

A "temporary memory" is also available, and does not occupy one of the main 20 memory channels. Unfortunately, using this feature is too complex to be of much use when driving, so its usefulness might be limited to fixed operation, where one could use the "temporary" memory like one additional channel.

Also, the PCS-7200, like the PCS-7500H, uses a "Tone Code Table" as a reference for CTCSS ("PL" tone) programming. That is, if you wish to program a "PL" tone of 156.7 Hz, this corresponds to Tone Code #25. When entering "PL" data into the Azden, the tone code display is a two-digit one, corresponding to the Tone Code Table printed on page 14 of the instruction manual. If you don't have the manual with you and need to enter some unique "PL" tone on the fly, you'll be hard pressed to remember which two-digit code corresponds to which tone. All the standard 38 CTCSS tones are in there, but it's nearly impossible to remember which one is which without the Table.

The Workhorse

The PCS-7200, for all its quirks, actually works very well. They call it a "MIL-STD-810" radio, which I assume means it is not actually military qualified, but is built to withstand the environmental extremes specified in this military document. I live in a "high-RF" environment that makes many inexpensive VHF/UHF rigs go bonkers with intermodulation products and receiver images: I'm up on a rise with a clear view for 20 or 30 miles in some directions, and that view is of a large city with countless high-powered transmitters populating every hilltop. I'm also just "under" a popular 3600'-high mountaintop bristling with so many transmitting antennas it appears much like a porcupine from here. While most handie-talkies and some mobile radios just roll over and die under the pressure of zillions of high-level signals pouring down the antenna feedline, the Azden doesn't. It just sits there, receiving even weak, distant signals, without a trace of "intermod." Its 25-watt transmitter is competitive enough (although some 222 MHz rigs run 35 watts, this is only 1.46 dB more power, hardly worth discussing) and is rock-solid. After 10 full minutes of continuous key-down time (OK, so I'm long-winded!), the Azden's power output doesn't fall off. Many of the "50-watt" 2 meter rigs start out running 50 watts or more when cold, but wind down to maybe 40 watts after several minutes of key-down time. The 25-watt Azden doesn't do this, and would probably make a good "remote base" unit capable of rather severe service.

Another "plus" in the Azden's favor is its remarkable receiver audio output stage and speaker. The rig is rated to produce 2 watts of audio power into an 8-ohm load at 10% maximum THD (total harmonic distortion), and it sounds loud, much like a commercial radio. I never had to crank up the volume control more than about halfway to produce room-filling (or car-filling) volume. The rig's top-mounted speaker is also top-notch and doesn't rattle the little rig's cabinet, even with the volume full up. This may sound insignificant, but I think it's a wonderful feature for a mobile rig—one I miss dearly when a rig can't provide enough receive audio to overcome road noise when operating mobile.

"While most handie-talkies and some mobile radios just roll over and die under the pressure of zillions of high-level signals pouring down the antenna feedline, the Azden doesn't."

Other Features

The memory and band scanning features of the PCS-7200 are as good as those found in any rig I've used. One can scan just the memory channels in "Bank A" (10, A0 through A9), "Bank B" (another 10, B0 through B9), or both A and B. When in the "direct" (VFO, non-memory) mode, the rig will scan between any two frequency limits; however, those limits must be stored in memories. For example, you could store 222.01 in memory A8 and 224.99 in memory A9 and scan between these two limits, thus covering the entire amateur band. You could store another set of lower and upper limits in memories B8 and B9, and scan just between those two. Pushing the PTT button on the mike, or depressing the UP or DOWN keys, the REV(erse) key, the M(emory) MODE key or the F(unction) key will stop the scanning, which may be immediately resumed by depressing the SCAN key again. The only problem is, if your scanning receiver stops on a repeater frequency which was not previously stored in memory, you can't just grab for the mike and start chatting on that channel. This is because the rig won't know exactly where to transmit: It does not have an automatic repeater offset function.

Like most modem FM rigs, the Azden also contains a PRIORITY mode feature. Activated by depressing the PRI(ority) key, this feature enables the receiver to look for activity on memory channel A0 (automatically the designated priority channel) every four seconds, regardless of where the receiver is actually tuned. If activity is present on the priority channel, a "beep" tone sounds in the speaker to alert you. A momentary press of the M A0 key on the front of the PTT hand mike immediately switches the rig from whatever channel it was on to the priority channel (A0). If you make this fast frequency change and then decide you didn't really need to, another momentary press of the same key will return you to the last channel you were on before switching to the priority frequency. I find this feature very handy, since I really do have a priority frequency around here—222.080 MHz, a popular simplex channel for the San Fernando Valley.

The factory-supplied PCM-499-23 dynamic hand mike contains a 16-key DTMF (TouchTone) encoder, as well as UP/DOWN (frequency selection) buttons, the "M A0" (priority channel) button described above, and a rugged coiled cord with attached 8-pin connector. The 16 keys are all softly lighted the same color as the Azden's panel displays, making buttons easy to find in the dark. (I wish all mobile microphones had lighted keys!) The TouchTone encoder produces an audible sound from the microphone itself, so you can tell if it is working. However, the PCS-7000 manual contains some misleading information regarding operation: It states, "To enable the DTMF encoder function, press the keypad keys correctly in the desired sequence. As each button is pressed, the LED will light. The transceiver is automatically put into the transmission mode when any keypad is pressed. The built-in 'hang timer' causes the transmitter to operate continuously if the delay between keystrokes is less than 2 seconds."

I didn't find any of this to be true. Depressing a key does not make the transmitter operate. I had to depress the PTT button on the side of the mike first. As for the "LED" lighting, there was no LED on the mike supplied with the review unit, so I don't know what LED they're talking about. Also, the "hang timer" doesn't exist on the review unit. If you release the PTT button, even if you're in the middle of a keying sequence on the tone pad, the rig stops transmitting. All these "faults" are forgiveable, but I wish Azden would update the manual to make it less confusing for neophytes who may actually become upset if the rig doesn't operate exactly as described. (In speaking with Azden since the review unit arrived, I determined that the new PTT mike does not function as described in the instruction manual, and that is normal. They say most users did not like the "push any button and you're transmitting" function, so they have revised this to be as I have described above.)

I like the mobile bracket Azden supplies with the PCS family of mobile rigs: uncomplicated, unobtrusive, sturdy and easy. Two of the four radio-mounting machine screws have attached plastic knurled surfaces which allow hand-tightening with no need for tools. The other two machine screws do require a Phillips screwdriver, but at least you can get the radio mounted temporarily, without it falling in your lap or on the floor, while you casually install the remaining two screws. This is a thoughtful touch. I also like the Azden schematic diagrams, which are large enough to read without an eye loupe and include a block diagram that clearly details (at least for the technically inclined) what's actually happening inside the rig.

Inside the Radio

Let me take a moment to describe the radio's "guts." Signals entering the receiver from the antenna jack pass through a diode T/R switch (hooray—no relay!) to a 215-230 MHz bandpass filter which is varactor-tuned to resonance by a special "loop filter" circuit programmed by VCO data. Signals are then amplified by a 3SK177 dual-gate MOSFET and bandpass-filtered once again by still another varactor-tuned circuit before driving the first receiver RF mixer. All this "track-tuned" bandpass filtering is probably what makes the Azden's receiver so immune to interference from outside the amateur band. The first mixer is another 3SK177 having LO injection at 200.4 to 203.4 MHz (for tuning 222.0 to 225.0 MHz), provided by a 2SC3838 "RX Lo AMP" buffer stage which receives its local oscillator signal from the VCO UNIT which is common to both the transmitter and the receiver. The receiver's first IF at 21.6 MHz is shaped by a 15 kHz bandpass crystal filter and this IF signal is then applied to "IC7," the receiver IF subsystem which contains a bipolar (2SC2715 common-emitter) IF amplifier, and an integrated circuit (MC33610) containing the second local oscillator, second mixer, second IF amplifier, discriminator and squelch circuit. The second LO runs at 21.145 MHz and produces a second IF at 455 kHz, which is bandpass-shaped by a 15 kHz multipole ceramic filter.

Table I. PCS-7200 Tests and Measurements

Specification	Measurement
Frequency range, 215-230 MHz (RX)	As specified
222-224.995 MHz (TX)	As specified
Transmitter output power: 13.8 VDC source, 50 ohm load	
25 watts (high)	24W
5 watts (low)	5.5W
Transmitter current drain: 13.8 VDC nominal source	
6.0 A (high)	5.5A
Unspecified (low)	2.3A
Transmitter overall power efficiency, Pout(W)/Pin(W):	
Unspecified	31.6% (high) 17.4% (low)
Receiver sensitivity:	
<0.12 µV at squelch threshold	0.10 µV threshold
<0.35 µV for 20 dB NQ	0.45 µV 20 dB NQ
<0.19 µV for 12 dB SINAD	0.27 µV 12 dB SINAD
Receiver selectivity:	
12 kHz min (total BW) at -6 dB	12.3 kHz/-6 dB
30 kHz max (total BW) at -60 dB	28.5 kHz/-60 dB
IF rejection:	
Unspecified	1st IF (21.6 MHz), 102 dB 2nd IF (455 kHz), >136 dB
Receiver current drain: 13.8 VDC nominal source	
0.6A	0.28A squelched 0.55A unsquelched
Audio output power:	
>2W into 8 ohms, 10% THD	2.4W, 10% THD

S-meter and power output meter bargraph display:
PCS-7200 uses a 10-segment display but segments 9 + 10 illuminate together, making for 9 increments of resolution.
Bargraph reading for full (25 W) output power: 10 segments
Bargraph reading for low (5 W) output power: 2-3 segments
S-meter readings vs. input signal strength:
1 bar = 0.45 µV
2 bars = 0.55 µV
3 bars = 0.65 µV
4 bars = 0.75 µV
5 bars = 0.87 µV
6 bars = 0.95 µV
7 bars = 1.35 µV
8 bars = 2.00 µV
9 bars = 5 µV

Note: PCS-7200 receiver can detect very readible signals before its S-meter bargraph display indicates any signal present.

All data taken by WB2WIK 12/26/94.

Demodulated signals from the IF subsystem are applied to a bipolar 2SC2712 audio preamp whose output is high-pass filtered by an integrated "HPF" 270 Hz rolloff filter (to strip away CTCSS "PL" tones from being heard) before being postamplified by a power integrated audio amplifier, IC5 (a TA7252). The receiver circuit contains other niceties like a three-stage "S METER AMP" circuit that amplifies then rectifies the 455 kHz filtered 2nd IF signal and an "AF MUTE" gate which switches off the drive to the final audio power amplifier on transmit. All in all, a good receiver design that results in sparkling performance under real-world conditions.

On the transmit side, speech from the microphone is first adjusted in level by a "MIC SENS" (mike gain) control VR2 before being applied to an integrated MIC AMP stage, IC11, which both amplifies and shapes the audio response before driving IC10, a 3.4 kHz integrated low-pass filter which rolls off noise and voice harmonics above the range of human speech. The speech audio from this filter is applied to the DEV(iation) control VR4 and then directly drives the integrated VCO UNIT (IC8), the same system which provides local oscillator injection for the first receive mixer. The voltage-controlled oscillator provides frequency-modulated signals directly in the 222 MHz range on transmit, so only RF power amplification, and no frequency multiplication, follows this stage. This surely reduces "phase noise" on the transmitted signal and helps assure close-in spectral purity.

The output from the VCO is amplified by three cascaded bipolar stages (Q11, Q12, Q13). The last of these stages (Q13, a 2SC2407) has "APC" (automatic power control) bias applied by the APC control circuit, which contains the HI/LOW power switching function and power output level adjustments for both HI (VR9) and LO (VR8) ranges. Bias from the APC circuit is also applied to the final RF power amplifier, IC501, a Toshiba S-AV15 hybrid ("brick") module located on the rear heatsink of the radio. The transmitter output from IC501 is filtered by two separate dual pi-section low-pass networks. Also located on the PA board is the transmit-receive (T/R) diode switch, which uses a pair of HI407s, one in series with the transmitter, and one in shunt with the receiver, to perform the switching function. I am unfamiliar with the HI407 and do not know if this is a P-I-N diode or not (but I hope so, as PINs are far better RF switches than conventional P-N

junction diodes, having less loss and better distortion product performance). Between the first dual pi-section TX filter and the series RF switch diode (and the second set of dual pi-section filters) is the directional coupler sampling network, which uses a 1SS106 detector diode to drive the APC amplifier system.

Again, the transmitter circuit appears to be thorough, complete and designed with minimal adjacent-channel interference in mind. Although I pointed out some shortcomings in documentation and operator convenience earlier, I must admit Azden does a pretty good job of making radios that work, even when the going gets tough. The PCS-7200 contains circuitry not always seen in amateur gear and more frequently found in commercial two-way equipment. I applaud their RF engineering, and only wish they'd make this rig more "user-friendly," without the complicated channel programming sequence.

I got the review unit programmed with 20 channels of local simplex and repeater activity, made a few dozen contacts (including bringing up some repeaters more than 150 miles distant not bad for a 25-watt radio!) and then spent a few hours conducting "bench tests" for receiver sensitivity and selectivity, and transmitter output power and current consumption. The results of my testing are shown in Table 1.

One additional comment I might make regarding the PCS-7200's transmit modulation: When I first tried the review unit, I received reports of unclear sibilancy (harsh "S" sounds), and "popping" B's and P's. I reported this back to Azden, who promptly provided me with another microphone. The second mike sounds the same as the first. Azden's Communications Division Manager, Sid Wolin K2LJH, recommended I try speaking across the mike, rather than directly into it, because this is a noise-cancelling microphone designed for the "talk across" technique. I tried this, but still received reports of uncrisp modulation. Listening in a second receiver with headphones, I must admit the modulation is not as crisp and clear as I'd like it to be. Some of this is attributable to the noise-cancelling dynamic microphone; when I tried a different brand of "desk" microphone, it sounded better and more natural. I won't downgrade the PCS-7200 for this, but must relate the experience in the interest of accuracy. Azden boasts about their "true FM" modulation (as opposed to phase modulation, used by some other FM transmitters), but without a better microphone transmit audio isn't all that great.

In all, I like the PCS-7200. What it lacks in ease of setup and documentation it makes up for with good, solid RF performance. Azden used to sell their products only "factory direct" in the U.S.; however, I see that Amateur Electronic Supply now distributes Azden products, and perhaps others will follow. The company has a loyal following among 10 and 6 meter FM enthusiasts, and there's no reason for 135 cm (and probably the other VHF band) users not to take a serious look at their products.

73 Review

Number 8 on your Feedback card

by Gordon West WB6NOA

Amateur Radio Education, Inc.
19032 Pauline Lane
Huntington Beach CA 92646
Telephone: (714) 968-0042
Internet: BGREGG@CALSOFT.COM.
Price Class: $75

Ham University Interactive

Learn code and theory, and play, CW games.

Learning Morse code and amateur radio theory on your laptop or home computer has now taken a giant step forward where no one else has gone before—interactive learning on a Windows format. No shareware nor existing code and theory programs come close to the excitement found in Ham University from ARE (Amateur Radio Education, Inc.), a new company specializing *specifically* in amateur radio software.

Ham University and the Pentode Morse code game cover any level of amateur radio education, from just getting started and not knowing a dot from a dash up to first class radiotelegraph speeds of 20 and 25 wpm. All levels of amateur radio written examinations cover the latest question pools, including the *new* Advanced question pool going into effect July 1, 1995. Ham University includes two sections to help you with the written exam, two sections to help you learn and speed-build your Morse code proficiency, plus the addictive game, Pentode, to help you master Morse code without really trying. We found Pentode a terrific way to get kids interested in learning the code and getting into ham radio.

Ham University installs easily on any 386 or higher computer, Windows 3.1, DOS 5.0 or higher. For the Pentode Morse code game, a sound card is required.

I really recommend the sound card for the entire program because of all of the great sound effects and code-shaping features that the program includes. Code shaping? This allows a code instructor or a volunteer examiner to create code audio with smooth attack and release sounds to eliminate the harshness of most computer-generated CW. Many code programs produce a "thump" that is quite disturbing when practicing the code, or sitting for a code test with a computer creating the exam. With Ham University, code, tone pitch, dit-dah ratio, sound shape, and spacing intervals are fully adjustable on the Windows format screen.

We found you could also begin learning the code with the exact progression of letters recommended by the American Radio Relay League, or the exact progression of letters, numbers, and punctuation marks recommended in our own Gordon West Radio School method. Or you can create your own method of learning the letters, numbers and required punctuation marks for CW.

"Several instructors have their own personal way of teaching certain letters and numbers first, and they can easily tailor the program specifically for their classes," comments Roy Stephens AC6CQ. "The program defaults to the lesson section first, which sets up a series of lessons that introduce the code gradually using the West or ARRL educational methods," adds Stephens.

We set aside 20 minutes twice a day to work a few students through the code practice, and in less than a week they were listening to "easy word" sentences made up of the code letters they had just learned.

Pentode

We then switched our students over to Pentode, a Michael Crick exclusive game for making code practice *fun.* You select which code characters you want to practice. The challenge is to click on the appropriate square for points. Your job is to get rid of the code character boxes by placing them in a central panel. Two characters placed side by side eliminate themselves. This is called a diode. You can keep the screen clear just by making diodes, but if you want a high score, you need to make triodes, tetrodes, and then the pentode.

When you play the code game, you make a triode when you place two similar characters on a diagonal, and then place a third character in the angle so that all three explode at once. You score when you place the final "A" into the slot marked "—." Your score increases very fast as you progress from diodes to pentodes.

If you're good at Morse code, you can keep several characters in your head and not

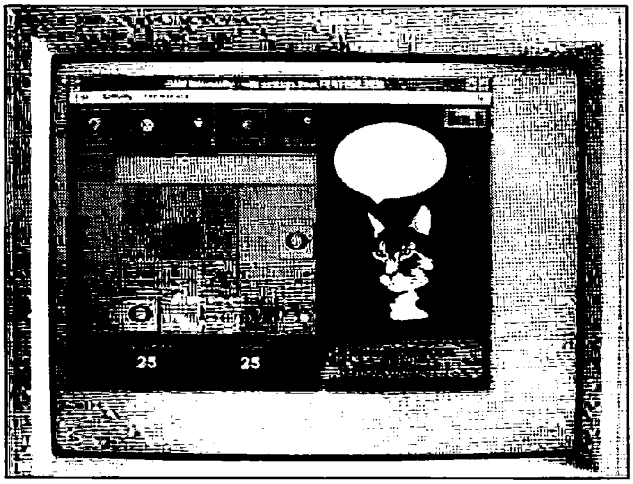


Photo A. Pentode is a fun game with Ham University to learn the code and to build speed. (Photo by Roy Stephens AC6CQ.)

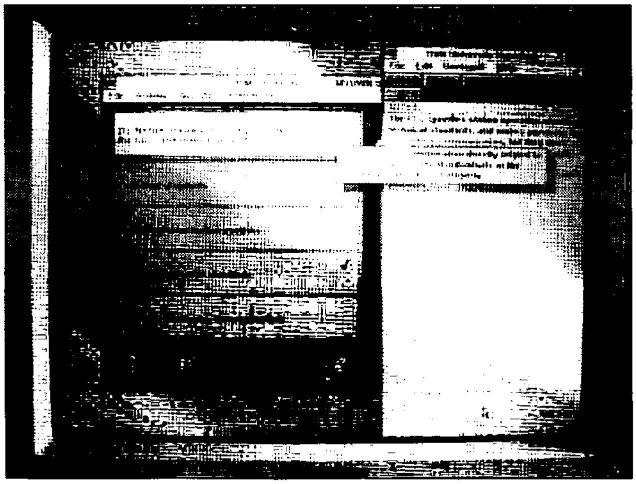


Photo B. All amateur test question pools are on the program, plus Hypertext help files. (Photo by Roy Stephens AC6CQ.)

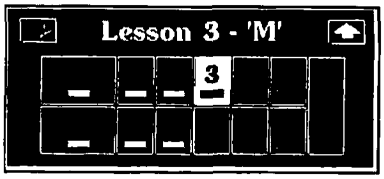
lose track of what is coming out of the speakers. This gives you multipliers that reward you for this type of stacking.

After 10 rounds (if you survive), you go from Novice to General, and then up through Advanced and ultimately to Extra. At each level, the Morse transmission rate increases.

If you don't know Morse code yet, and just want to play the game, Ham University Pentode can provide the option of having spoken characters instead of Morse code. This option is set from the Pentode dialogue box.

When you complete a game, your score may be eligible for the Hall of Fame. Your kids will probably get there first. And for you grown-ups, if this game sounds a little bit complicated, let the kids try it and they will soon be telling you how to play the game. Chances are they have played other Crick games of this style and the only thing new will be learning the sounds of Morse code to come up with letters.

They don't even realize they're learning a new language called "Morse code"!



The Upper Panel (above) shows you which lesson you are on and shows you which drill is next. You can change the drill by clicking the appropriate button. Each lesson emphasizes a given letter -- the drills in the top row strongly emphasize the current letter and those on the bottom row mildly emphasize it. You can advance through the drills in order or skip them if they are too easy. You can not advance to the next level until you pass the drill marked End. The first drill in each row marked Free lets you go at your own speed -- the others present groups of letters at a fixed speed (which can be set in the Lesson Plan Dialog Box).

You start each drill by clicking  or pressing Enter. Then type the letters you are receiving into the lower panel. Case is ignored and spaces are added automatically. When you complete the drill, the letters that were sent appear in the upper panel so that you can compare them to what you typed.

Sent	ME~EE~ET~MT~MM~TE~ET~MM~TM~TM~TM~MM
Recd.	ME~EE~ET~ME~MM~TE~ET~MM~EM~TM~TM~MM

Morse Code Test Preparation

We found the Morse code test preparation exercises identical to the methods used by volunteer examiners and VECs who create code tests. And while there are many variations of how a 5, 13, and 20 wpm code test can sound, and what the basic format of the QSO will be, Ham University has so many different types of code tests that you will be well-prepared for anything that may come down the earphones or speakers at your upcoming VE exam.

And for credentialed volunteer examiners with Ham University, you can create a legal 5, 13, 20, or commercial radiotelegraph second class or first class code test that specifically meets the FCC guidelines for CW test administration. This includes the new code tests for both random and text for the commercial radiotelegraph code examination Elements 1, 2, 3, and 4, and amateur Elements 1A, 1B, and 1C.

The Morse code section of this program had almost twice the variable features as other CW programs I have seen and have used extensively for my own code teaching and code tapes. This was instantly recognized when I saw I could actually shape the sound of the code characters coming out of the audio board speakers!

Theory Preparation

For amateur radio theory learning, Ham University gives you more than just questions, answers, and a beep or boop on the correct answer. You get applause. You get cheers. You get AAAHHHAAASSS when your high score appears after a sample exam. And this makes taking the tests *fun* because there is a surprise right around the corner with every click of the mouse.

We also see "hypertext" in case you have a problem with any one of the questions on how the correct answer was developed. Theory instructor Bob Gregg AB6CH patterned the "hypertext" similar to the brief descriptions found in my theory books, and he came up with some great descriptions on how to solve for the right answer, with some shortcuts that I never even thought of! Gregg actively teaches ham radio, so he knows what the students are looking for.

Having the code, theory, and Morse code games in a Windows format puts this program in a timely step with popular computer technology. You're learning 1995 code and theory at a 1995 computer level unlike other programs running much slower and on a basic DOS format. Needless to say, you need a modern computer to work this program, so this could very well be a great excuse to upgrade your system and make ham radio education more fun.

Priced at under $75, Ham University is available from Amateur Radio Education, Inc., 19032 Pauline Lane, Huntington Beach, California 92646; 714/968-0042; Internet BGREGG@CALSOFT.COM.

Number 9 on your Feedback card

73 Review

by Richard Goodman WA3USG

Personal Database Applications
2616 Meadow Ridge Rd.
Duluth GA 30136-6037
Telephone: (404) 242-0887
Price Class: LOGic 4 Windows—$99; LOGic 4 DOS—$79.

LOGic 4

Ham radio software for Windows or DOS.

In the May 1992 issue of *73* I reviewed Personal Database Applications (PDA) LOGic II Version 2.1 Ham Logging Software. I was favorably impressed and have since been using it for my personal amateur logging requirements. About a year later, I received LOGic Version 3. This included many enhancements, the foremost being a Packet Cluster interface and a move to a "Windows-like" environment. While LOGic Version 3 was still a DOS application, it used several windows that could be individually moved, sized, and configured. It also made liberal use of pop-up menus and included mouse support.

The programming environment that LOGic is written in has also changed. The original Version 2.1 was written in "DBMAN," a fine commercially-available applications development system in its day. Version 3 and above are written in FOXPRO, a state-of-the-art applications development system providing considerably more performance and features than its older cousin. Finally, I was impressed by the fact that the LOGic System has gracefully evolved over the years from a capable but complex DOS application to an integrated system of amateur radio control. LOGic now provides a Graphical User Interface through Windows or DOS to: logging, rig control, communications (Packet Cluster Interface and terminal program), awards tracking, access to several ham databases on disk or CD-ROM, and an extremely powerful reports generation system.

Installation and Configuration

LOGic-4 requires an IBM-compatible PC with at least a 386SX microprocessor, and 7 megabytes of free disk space for Installation. If LOGic is to be installed and run as a Windows application, Windows Version 3.1 with at least 4 megs of RAM are required.

LOGic is available in DOS and Windows versions. The DOS version features a Windows-like interface with full mouse support. The Windows version is the product of choice for those who prefer a true Windows interface. Both versions may be purchased at a substantial savings and will allow you to access the same data from DOS or Windows.

This review covers primarily the Windows version. The DOS side works just as well with access to all the same data. (The Windows version allows changing of screen font types and sizes that are not available under pure DOS, which does support 25-, 43-, or 50-line display modes).

Installation is virtually automatic. Run Windows and insert the first 3.5" floppy containing the LOGic system. From the "FILES" option in the Program Manager select "RUN" and type: X:\SETUP (where "X" is the floppy drive designation). Installation under DOS is even simpler. From the DOS prompt type: X:\SETUP (where "X" is the floppy drive designation). You will be prompted to install additional disks as necessary.

As the system installs itself, you will be graphically appraised of the installation status. PDA makes liberal use of bar charts and other graphical indicators to show the creation of files, indices and tables.

Upon completion of installation you must enter the "General Ham Setup" menu and tell the system a few things about yourself (e.g.: callsign, lat/long, operating modes, UTC offset, etc.). Once this is done, the fun can begin.

Documentation

The documentation included with LOGic 4 is excellent. It is professionally bound and typeset with laser print quality. It is easy to read and Includes both a table of contents and an index. The document is broken down into two sections. Section 1, "Basic Operations," consists of 64 pages and will do for us what we hams seem to demand: get us going quickly with little reading. Section 2, "Advanced Operations," contains 41 pages and gets into all the nuances of this system.

LOGic 4 lends itself well to the neophyte who wants to start with basic logging requirements. Many people would be happy using only 25% of its capabilities. To realize the true potential of the LOGic system, however, it is necessary to thoroughly read all of the documentation and experiment with the program.

Operation

To the experienced Windows user, the basic functionality of LOGic 4 will be almost intuitive. The first screen presented after clicking on the "PDA LOGic" icon from the program manager will be the PDA logo with the main menu. Menu options may be selected by either typing the first letter of the option or clicking on it with the mouse. Noted that this system may be totally navigated with the mouse; it is no longer necessary to tab or navigate with the arrow keys. The cursor may be placed anywhere on the screen by positioning it with the mouse and clicking on the

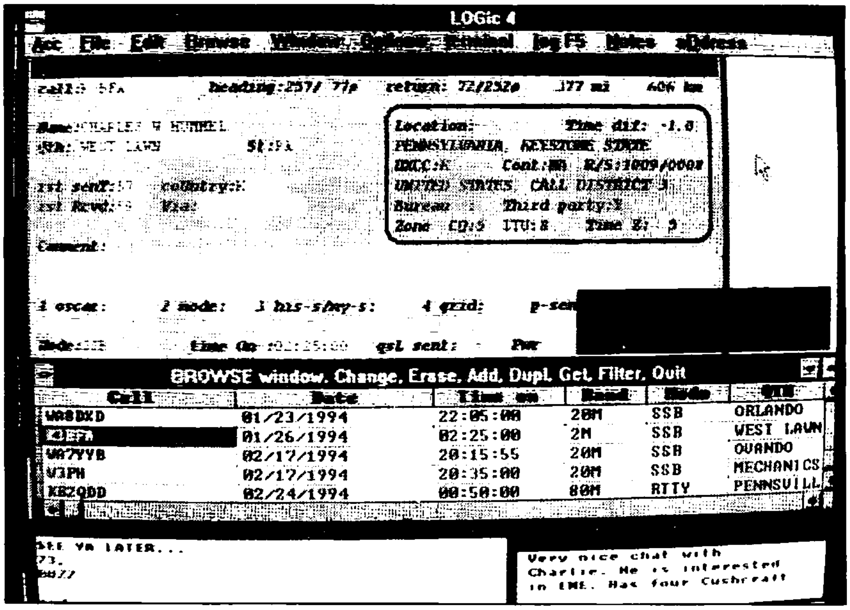


Photo A. The LOGic 4 logging screen that the author edited to be his default logging screen.

desired destination.

Clicking on the "Logging Screen" option from the main menu selects the default logging screen. I say "default" because this logging screen may be edified to show more or fewer fields, completely new user-defined fields may be added, and windows may be moved, resized or minimized. Photo A shows the logging screen that I edited to be my default logging screen. Since I work satellites, I added an "OSCAR" field to note what satellite I was using. I also added a "MODE" and "S-meter" reading fields to enable the collection of some specialized data. Since I am also active on fast-scan ATV, I added a "P-SENT/RCVD" field to record ATV signal report readings.

I like to use one logging screen for all my routine requirements. There is no reason, however, that separate logging screens for satellite operation or other specialized modes couldn't be created. With LOGic 4, Personal Database Applications supplies logging screens for all major contests. These are accessible from the main menu under the "Select Logging Screen" option. There you will find a menu-driven selection of contests, from "CQ World Wide" to the ARRL VHF Sweepstakes. If you should find a contest that is not included, an existing screen may easily be modified by the user and saved under the "Logging Screen Select" menu. For all contests, LOGic knows how to calculate multipliers and other unique contest parameters.

Another nice feature of all logging screens is that the fonts in most windows may be changed and resized. If you have obtained additional fonts for Windows (eg: Adobe Fonts), they may also be used with LOGic. Their selection is as easy as with any other Windows application: Simply click on the font type and click on the size.

The logging screens are attractive, colorful, and functional. There is a "Browse" window that emulates the *ARRL Logbook* format. It may be moved and sized to the preference of the user. In this window, the fonts may be changed and resized, allowing for a lot of data to be displayed. An individual QSO may be selected with the mouse, or by using the arrow keys to navigate. The "Browse" window also uses horizontal and vertical scroll bars to display data off the top or bottom of the screen.

The log screen itself may be configured by the user to display any data desired. The log screen is where the user actually enters the data applicable to a QSO. Upon entering a DX callsign, the LOGic system computes and displays a variety of information about the station. The long and short path headings, distance, location, time zone, third-party traffic restrictions, CQ zone, and many other attributes of the station are quickly and attractively displayed. As you enter data in the different fields, many entries are automatically edit-checked for validity and accuracy. You will be notified if you enter an invalid mode, or any parameter outside of the program specifications. The system can even warn you if you're outside the frequency limits of your license class. LOGic also interfaces to a variety of ham databases and will display in real time all available information about the station as soon as you enter the call.

I like to keep a lot of free-form notes about my QSOs. LOGic 4 has a "Notes Window" on the logging screen that may be selected by a click of the mouse. This window is accessible from anywhere on the logging screen, even if you are in the middle of logging a QSO. It may be resized and moved anywhere you want on the screen. A virtually unlimited amount of text may be entered. LOGic provides automatic text wrap and scroll bars if there is more text then can be displayed in the window.

The logging screen also displays a real-time clock in both local time and UTC. Finally, it includes a window to your TNC as part of a complete Packet Cluster Interface.

LOGic will interface to a TNC or multimode controller connected to either COM1 or COM2 (the on-line help also explains how to use COM3 & COM4). The system will use its awards table to notify you in real time of stations that are needed for DXCC, CQ zones, ITU zones, WPX prefixes and others. It will even filter the packet data through the band table to suppress announcements of stations that are outside of your license class. The extent of the filtering for this function is con-

trolled by the user. This data will appear in the Packet Cluster Window on your logging screen with an audible CW signal (or voice announcement if you have a sound card) for those stations that meet the selection criteria. LOGIc also contains a terminal program useful for logging on to BBS systems and holding packet/RTTY/AMTOR QSOs if you are equipped with a multimode controller.

While I did not review this function, LOGic also contains a CW keyer that uses a parallel printer port (LPT1 through 3) via a simple interface. LOGic includes a schematic on how to build the interface in the on-line help! Alternately, you can purchase a completed interface from PDA.

Complete control of most transceivers capable of computer interface is included in LOGic. Between the documentation and online help there is a wealth of information that should enable this to be accomplished without undue hardship. I was impressed with the detail that PDA included in support of this function. They even included a transverter offset to enter/display the correct frequency for those rigs driving a VHF or UHF transverter.

Finally, LOGic will interface with any antenna rotor with an RS232 interface. If enabled, it will automatically point your antennas along the short or long path as displayed on the logging screen. There is also a table to hold user-definable azimuth offsets to compensate for coupling between antennas on the same boom or non-standard antenna patterns.

Awards Tracking and Reports

Awards tracking with Logic 4 is almost too easy! Click on the "LOG" option from the main logging screen and select "Awards Tracking." You will be presented with a pull-down menu of award categories (LOGic tracks all known awards and user-definable awards may be added). Click on the award whose status you need to know and a "Progress Summary Modification" menu is presented. Here you can modify the filtering criteria for the award (e.g.: single-band WAS vs. summary of all bands). Select your modifications (or leave it blank for all-band/all-mode summary) and press <enter>2. A window pops up displaying all necessary statistics. Here are my stats for Worked All States (Gee . . . not too good for 21 years of hamming!)

Worked....................49
Confirmed....................43
Worked (QSL pending)....................0
Worked (no QSL requested)....................6
Worked (unconfirmed)....................6
Unworked....................1
Total Uncomfirmed....................7

While this data may be displayed in real time on the screen, LOGic also allows the user to generate various hardcopy reports for all known amateur awards! These reports are attractively formatted and will be indispensable to the serious certificate hunter.

Finally, on the subject of reports: LOGic will print your logbook, awards, and other statistics in virtually any format that you wish. The system comes with a variety of "canned" reports that will satisfy 99.9% of even the most serious operators. However, all reports may be modified in format and content with mouse-driven point, click and drag commands. All reports may be edited and previewed in true "What You See Is What You Get" graphical format. New reports may also be created with virtually any information entered in LOGic displayed.

PDA also offers a QSL route list. This option is a database of QSL managers that is automatically accessed in real time as you enter a DX call into your log. It contains over 28,000 QSL managers and addresses.

Summary

There is simply not enough room for this article to completely cover all aspects of LOGic. PDA has entered the marketplace with a state-of-the-art Graphical User Interface (GUI) system of amateur radio control that will set standards of performance. Functionally and cosmetically, LOGic met or exceeded all of my expectations and would be a real asset to any computer equipped ham shack.

LOGic 4 Windows is $99; LOGic 4 DOS is $79. If you purchase the Windows Version, the DOS version may be purchased for an additional $20. There are also upgrade prices from earlier versions.

Number 10 on your Feedback card

73 Review

by Jeff M. Gold AC4HF and Michael A. Czuhajewski

S & S Engineering's PC-1 Programmable Counter Kit

S & S Engineering
14102 Brown Road
Smithsburg MD 21783
Telephone: (301) 416-0661;
Fax (301) 416-0963
Price Class: Without case—$69.95;
With case—$99.95;
Assembled—$139.95

A low-cost, add-on frequency counter you can build.

I work hard and I play hard. Many times my play centers around ham radio. I find building very relaxing. Sometimes I work so hard that although I really feel like bulidlng something, I don't feel like tackling a large project. At times like these I really enjoy building station accessories. I have an HW-9 QRP transceiver that I built. It has the extra WARC pack so it covers eight bands. The analog dial is fairly accurate on most of the bands, but not all. When arranging schedules it is often nice to know exactly where I am. A digital readout that could sit on top of the rig was just what I wanted.

S & S Engineering puts out top-quality kits. They use top-quality parts and provide excellent clear instructions. They have recently come out with the PC-1 programmable frequency counter kit. This counter was designed to provide builders and experimenters with a low-cost counter which can be programmed to start its count at any desired figure. It can also be programmed to count either up or down, and to suppress or not suppress leading zeros. There is an option for AC power and a super-sturdy extruded aluminum case. When the counter is built and put in the case it makes an excellent external digital display.

S & S takes great care in preparing their kits. Parts are packaged separately and clearly labeled. It is usually a good idea when you first get a kit to take out the parts and separate and label them. This helps avoid putting parts in the wrong place on the printed circuit board (one of the two leading causes for failure of the kit to operate properly once built.) It also allows you to check off the parts and ensure all have been included with the kit. I found that with the way the parts were packaged, I didn't have any need to separate them any more than had already been done. I even found that the IC chips were placed on the foam packing in the order in which they were to be placed on the printed circuit board. Since separating out parts is not something I enjoy, all this made the kit more enjoyable to build.

The printed circuit board is of the absolute highest quality. It is solder-masked on the bottom, which almost eliminates the possibility of solder bridges (the other major cause of kit failure.) The silk-screening is excellent, which makes parts placement much easier. The board also has plated-through holes, making it easier to solder. The solder almost seems to get sucked up into the holes. It also makes for much more secure solder joints. The downside is that you must be much more careful placing parts: With plated-through holes it is much harder to remove a part once it is soldered on the board.

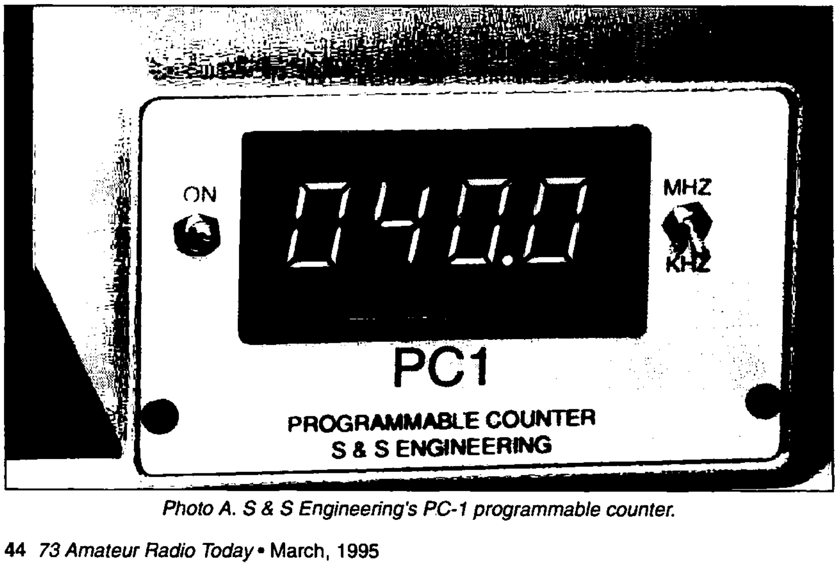


Photo A. S & S Engineering's PC-1 programmable counter.

Another area of detail that makes a kit more pleasurable to build is the quality and clarity of the instructions. I would rather have almost no instructions and a schematic than confusing instructions. S & S provides very clear instructions. The instructions are divided into an introduction that tells you how to get started and the options you have to build the kit as a counter with the display attached to the board, or how to separate the display if you are going to use the counter as a frequency display for a rig. There are then two pages of building instructions. They aren't in the Heathkit form that tells you which hand to hold the wire in, but they are very complete and clear. Next come two pages of alignment instructions. You only need to set one variable capacitor to get the frequency correct at a test point. Next, you set the DIP switches in various positions and test out the functioning of the counter. If you are going to install the counter in a case, Instructions are provided for that. I installed mine in one of the S & S cases to use for a display for the HW-9. There are six pages of instructions on how to operate and program the counter for use with various types of VFOs and for different applications. There is also a page on theory of operation. I always appreciate this information as I am continually trying to learn more about how things work. There is a very clear page that shows the parts placement on the PCB (printed circuit board), nice schematics and detailed parts description sheets. I use the parts description sheet as I am placing the parts on the PCB.

I found building the kit to be a total pleasure. The parts count is relatively low and the quality and preparation that S & S has put into the kit really adds to the enjoyment of building it. I did not encounter any problems

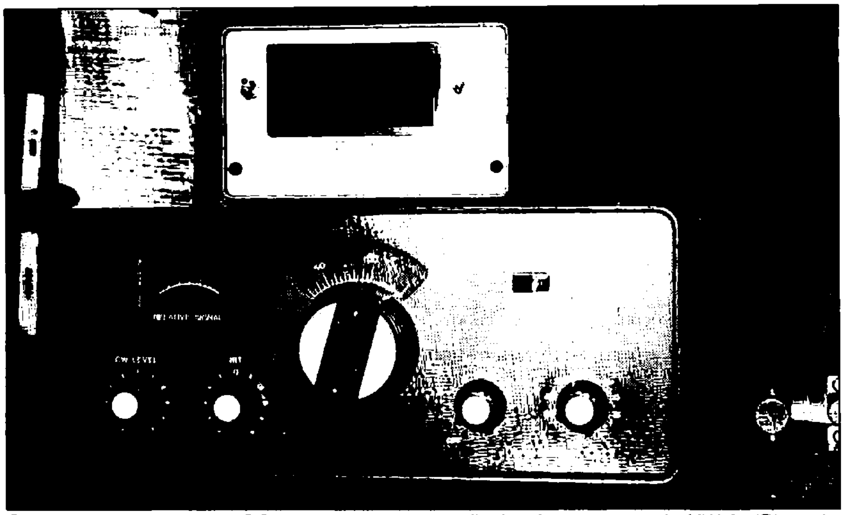


Photo B. The completed PC-1 used as a digital display for the author's HW-9. (Photo by AC4HF.)

with the instructions or with parts not coming with the kit. If you run into any problems you will find the folks at S & S to be a great and friendly source of help.

Technical Description

Operation is straightforward and, for the most part, similar to other counters. The input signal is conditioned a bit, then allowed to pass to the counting circuitry during a precisely controlled sample period. The results are then displayed with four digits, in either MHz or kHz format. Unlike most counters, the PC-1 can also be used as an external digital display with any VFO-controlled rig.

After a bit of preliminary division, counting is done by a 7217A chip, which also drives the readout. A switch toggles the display between MHz (00.00) and kHz (000.0). Since the PC-1 is intended mainly as a digital display, it has provisions for presetting the counter chip. Normally, a counter would start at zero and increment as it counts a signal. However, many rigs use a mixing scheme to generate signals, with the VFO at something other than the operating frequency. To accommodate "odd" VFO frequency ranges, the starting count can be offset from zero; this programming is done with DIP switches, and is explained In detail in the manual. The PC-1 can, of course, also be used as an ordinary counter by leaving the offset at zero.

In some cases, a VFO might tune backward, I.e. decrease in frequency as the output frequency increases; another dip switch lets the PC-1 take this into account. Finally, the user can turn off leading zeros in the display (although the manual recommends against that, to avoid confusion).

The signal from the input jack is applied to a resistor and a pair of diodes to provide protection for the input circuitry. It then goes through three transistors—an emitter follower buffer amplifier, a stage of gain, then another buffer. Next, it is applied to a divide-by-two counter; the output of this stage is allowed to pass for the duration of the 200 millisecond gate period. The 200 ms sample of the input frequency is then passed to a divide-by-10 counter, followed by a divide-by-100 stage. Depending on whether the MHz or kHz

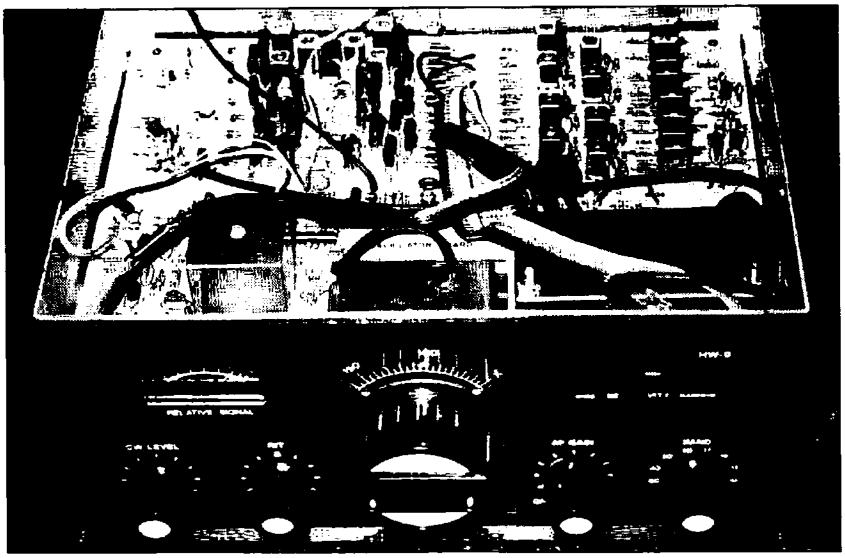


Photo C. Only one wire (which you can see exiting at the left rear) and a ground were needed to connect the PC-1 counter to the HW-9.

display is selected, the signal from either the input or output side of the divide-by-100 stage will be fed into the counter/display chip. The signal is then counted and the results are displayed.

The sampling period is developed by a 4.096 MHz crystal and a 4060 oscillator/divider chip. Its output of 250 Hz is further divided to provide the 200 millisecond gating pulse. Adjustment of the oscillator requires another counter or a synthesized general coverage receiver capable of tuning to 4096 kHz. Unlike many counters, its timebase cannot be compared directly with WWV. DC voltage of 7 to 15 is required to power the PC-1, with an internal three-terminal regulator dropping it to 5 volts. Nominal current draw is about 120 milliamperes. With the AC option, it may also be powered from 6.3 to 12 VAC.

Using the Accessory

After I went through the alignment and checkout procedure, I was anxious to try my display on my Heathkit HW-9 QRP transceiver. I want to keep my HW-9 in original condition, so I am careful to make sure any modifications I do are easily reversible. I wanted to attach the PC-1 without drilling any holes or changing any wiring if possible. I decided I could run the one necessary wire into the rig by leaving out one of the case screws and hook the ground for the counter to a grounded case screw in the rear of the rig. I soldered the counter wire to a test point in the rig and read the frequency. Using my main station rig and another counter as checks, I determined the frequency the HW-9 was actually on. I next followed the programming instructions provided in the S & S documentation and programmed the counter to read the actual operating frequency.

It worked great. I now know exactly where I am on any band. I love turning on the display and tuning across the band. One of the nice things about ham radio is having these flashy gadgets to watch as you are operating. The counter works great and it was worth the price simply for the enjoyment of building the kit.

HAM HELP

Number 11 on your Feedback card

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2"x 11") sheet of paper. Please indicate if it is for publication. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Anyone needing a QSL from WA9KAG can get one from **N9OZW** (his son). WA9KAG became a silent key on 18 Sept. 1994. Please include QSO info and SASE. *Pat Malott N9OZW, 1515 W. 1000 N, Laporte IN 46350.*

NEEDED: Any manuals or programming information for ROCKWELL-COLLINS HF-281. I am willing to pay copying and/or postage costs. Thank you. *Art Kenck WA7STB, 2452 Skyline Dr., Salt Lake City UT 84108, Tel. (801) 583-1519.*

I am trying to locate Heriberto Sanchez TI5HK, who resided in St. Louis MO in 1958. *Nate Williams W9GXR (ex KOCHE), 6915 Prairie Dr., Middleton WI 53562.*

Does anyone have an address for Electro-Voic Inc. of Buchanan MI? I am also looking for information on a log-period that covers 6m and up. Thank you. *Noel P. Larson, HC86 Box 3860, Merrifield MN 56465.*

I am trying to locate Radio or Radar Techs who served at Site #12, Sakata, Japan. *Roger Freeman, 2134 Allegheny St., Duluth MN 55811-3210. Tel. (218) 722-6890.*

WANTED: To complete my collection: February 1989 issue of *73 Magazine*. I will pay postage and a fair price for the magazine. Thanks. *Sieb Klaassens VE3JUA, RR #3, Elmwood ON, Canada N0G 1S0. Tel. (519) 369-3262.*

I need a tube 4QP2 or 4QP31 for an older Army-Scope. Offers by mail or FAX to *H. Schroeter DK3VF, Moorfleeter Deich 503, 21037 Hamburg, Germany. Tel/Fax: 040 / 7374246.*

NEEDED: Instructions to convert the RADIO SHACK Handheld Realistic FM Transceiver (49 Mc.), Model TRC-505; Cat. #21-405, to the 6 meter ham band. I will pay for magazine or copy, and postage. Thanks. *John Wora K2KFG, So. 4907 Clifton Pkwy., Hamburg NY 14075-3341.*

When you call or write to our advertisers— Tell them you saw their ad in 73!

ATV

Number 12 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

ATV Christmas Present

Twas the night before Christmas and all through the house not a creature was stirring 'cepting me in my shack. When all of a sudden there came such a clatter, from out of the speaker came 2 meter chatter. With visions of DX dancing 'cross my eyes, I tuned up my TV and was quite surprised! There were Iowa, Missouri, Illinois and Wisconsin; Ohio, Indiana, Kentucky and PA; New York, Arkansas and Michigan too; it was certainly an ATV dream coming true!

The Big Opening

As some ATVers put it during the marathon band opening that began Christmas Eve and continued for three straight days, this had to be the Granddaddy of ATV band openings; conditions not seen since the great opening of Thanksgiving '86. Although contacts exceeding 2,500 miles have taken place over water (Hawaii/CA—the Great-Granddaddy of openings), it's pretty rare for contacts exceeding 500 miles to take place over land. These contacts took place with regularity during this opening with signal levels often approaching P5.

The 2m ATV calling frequency (144.34 MHz) sounded like 20 meters during a rare DX pile-up. Video was flying fast and furious on 439.25 MHz over a several-state area stretching from Arkansas and Missouri all the way east to western New York State.

There was a large high pressure area centered over the region that produced clear, cold weather conditions with nearly 100% humidity and no wind. Thick layers of frost settled over everything and a dense fog formed over a large portion of the Midwest. This set up an incredible tropo condition that slowly worked itself toward the east over the next few days. Christmas Eve saw many contacts between Ohio, Michigan, Indiana and Illinois, as well as Iowa to the west. During Christmas Day, Tom Para WA8ZAH in Cincinnati, Ohio, worked Elmo Knoch K4YWL in Osage, Arkansas, with nearly P5 pictures exchanged (a distance of 540 miles; see Photo A).

The opening never seemed to die out even during daylight hours and really stretched out on Monday night and into the wee hours of Tuesday morning. The most notable contacts were between Dave Williams WBØZJP (O'Fallon, Missouri) and Jim Dallas KA3FZF (Monroeville, Pennsylvania), with P4 to P5 signals over a 594-mile path (see Photo B), and between WBØZJP and KA8VWV in Moundsville, West Virginia, (P2 levels) at 535 miles.

Many ATV repeaters could be seen across the region; it was quite fascinating to watch the DX rolling through a repeater that was hundreds of miles away. There was even one report that the Columbus, Ohio, ATCO repeater was seen in Nashville, Tennessee.

By Tuesday evening there were dozens of ATVers still active (most with cases of severe sleep-deprivation). This time contacts were made in a mostly north-south path between Michigan, Ohio, Kentucky and Penn-

Photo A. Tom WA8ZAH in Cincinnati, Ohio, and Elmo K5YWL in Osage, Arkansas, exchanged nearly P5 pictures during Christmas Day over a 540 mile path. Off-the-air video digitized by Tom WA8ZAH.

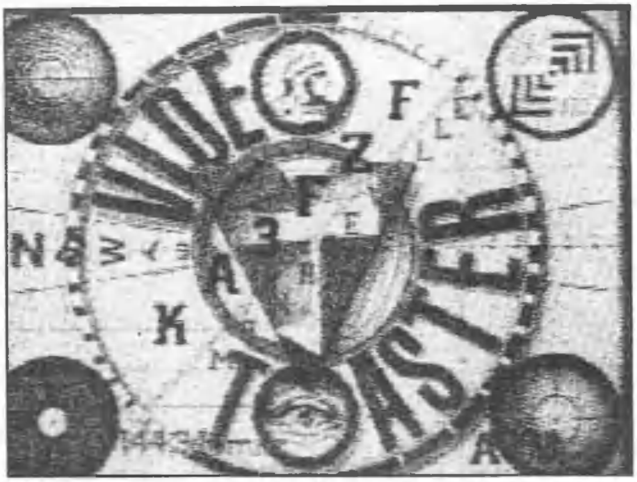


Photo B. This 594-mile contact, a new overland record, was made between Dave WBØZJP in O'Fallon, Missouri, and Jim KA3FZF in Monroeville, Pennsylvania, during the height of the opening. (Photo by Tom WA8ZAH.)

sylvania. I was having fun working through the WA4GSS repeater in Huntington, West Virginia. It was great to watch the local ATV gang, sending pictures through a repeater over 200 miles away (round-trip distance of 400 miles). Just before midnight a front moved through the area and the band finally slammed shut! It had been quite an adventure and once everyone catches up on their sleep I'm sure they'll be looking forward to the next big DX adventure.

DX Hints

You don't need a super-station to work DX. Paying attention to a few details when building up your ATV shack will help you reel in the rare ones. The number one key to success, in my opinion, it to put the most effort into your antenna and feedline. Sticking your antenna above the treetops and using a decent type of feedline (9913-type or hardline) will vastly improve your reception. Cheap hardline can be usually had for the asking at your local cable TV office. They have lots of surplus end runs that they'd love to have you take away You can then use matching sections (ZD Engineering, 419-424-8765, makes an economical version) to transform the impedance to 50 ohms. In the Midwest, mount your antenna horizontal for most DX work.

One trend I've seen in areas that have ATV repeaters is the tendency for newcomers to fix a low-gain antenna at the repeater. These stations will be left out in the cold during a band opening, seeing only the very strongest stations that happen to make it through the local repeater. It's well worth adding a rotator to your antenna, even if it's only the cheapest type available. In those areas with vertically polarized repeaters, one trick I've used with great success is to mount my antenna to a U-100 type rotator that actually flips the antenna sideways to change polarization. I now have the best of both worlds and can easily change from repeater reception to DX with the flip of one rotor control.

Also pay attention to large high pressure conditions with clear, still nights and high humidity. The best conditions seem to occur during late evening and just before sunrise. I've seen some truly amazing openings occur at 3 a.m., but there's usually no one to work! I always check out the lower UHF commercial channels, if you see lots of new channels coming in strong, it's time to check out the ham TV band!

The large number of participants in this opening can be attributed to the holiday season (lots of ATVers home in their shacks) and to the use of a single ATV calling frequency on 2m (144.34 MHz). If you live in or near the Midwestern part of the country, give a listen to 144.34 and you might be in for a real surprise!

HAMSATS

Number 13 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

A New Russian Star

On December 26th of last year, RS-15 became our newest amateur radio satellite. Launch was from the Baikonur Cosmodrome, 1,200 miles southeast of Moscow, near Tyuratam, at 0300 UTC. The launcher was a three-stage "Rokot." The first two stages came from a modified SS-19 intercontinental ballistic missile, while the third stage was a new booster called "Briz." Rumors of the impending launch of RS-15 have been circulating for years. The long wait is over.

RS-15 carries a single Mode "A" transponder with the standard 2 meter uplink and 10 meter downlink. The uplink passband is from 145.858 to 145.898 MHz, while the downlink spans from 29.354 to 29.394 MHz. The transponder output power can be varied with a maximum output of 5 watts. There are two telemetry/message beacons on the craft, one on 29.352.5 MHz and the other on 29.398.7 MHz. Power output of the beacons can be set at 400 mW or 1.2 watts.

The satellite is spherical and just over a yard in diameter. The system is built on a structure similar to the popular RS-3 through RS-8 satellites. It weighs approximately 154 pounds and has no orientation or stabilization systems. Early observations indicated that it was spinning about 34 times per minute shortly after launch.

Who Built It

The radios and control circuitry for RS-15 were built by a group of radio amateurs in Kaluga, 112 miles southwest of Moscow, under the direction of veteran satellite designer Aleksander Papkov at the Tsiolkovskiy Museum for the History of Cosmonautics. Valentin Yamnikov at Nilakt Posto (Aero-cosmic Laboratory) in Moscow provided coordination for the effort.

Control of the spacecraft is implemented by the RS3A control station in Moscow, headed by Leonid Maksakov and sponsored by Unicom in Russia and UTC in Rhode Island. RS3A is also the control station for RS-10/11 and RS-12/13. Reports and comments can be sent to RS3A at P.O. Box 59, Moscow 105122, Russia. They also have the packet address of RS3A @ RS3A.MSK.RUS.EU and the Internet address of regroup@olymp.msk.su. If all else fails, use the FAX with appropriate prefix: 7-095-916-2949.

A Tall Orbit

Although RS-15 has an orbit that classifies it as LEO (Low Earth Orbit), this satellite is the highest operational hamsat of its type. The *MIR* space station flies at just under 250 miles. *DOVE*-Oscar-17 has twice the height at almost 500 miles. The other RS systems, RS-10/11 and RS-12/13, orbit near 620 miles but RS-15 tops them all with a mostly circular orbit near 1,250 miles. *Kitsat*-Oscar-23 is the next highest LEO hamsat at 815 miles.

RS-15's high altitude requires nearly 128 minutes per orbit. The *MIR* space station takes less than 90 minutes for one revolution.

Another feature of RS-15's orbit is the inclination. It is 65 degrees. A polar orbit is near 90 degrees, while an equatorial orbit is at zero.

The high altitude means more passes per day for a given location, mora time per pass and the possibility for better DX. The 65-degree inclination changes the pattern of the orbits with respect to timing of passes and the path across the sky. Polar-orbit satellites travel from pole to pole. RS-15 may often track like a polar satellite until it reaches higher latitudes when it begins an apparent curve.

RS-15 is not in a sun-synchronous orbit. This means that it does not come by at the same time each day. Over a period of weeks orbits over a given location will occur a few hours earlier. For satellite users the situation is not bad since RS-15 is in view for many passes each day.

Telemetry

Those monitoring the CW telemetry beacon on RS0-15 during the first weeks after launch were treated to the following message: CO CO CQ DE RS15 AND RS3X MERRY CHRJSTMAS AND A HAPPY NEW YEAR. The spelling may have been a bit off, but the message was clear and the results delightful. RS-15 would provide new opportunities for satellite enthusiasts and was an excellent Christmas present.

Along with the message, telemetry can be heard. The basic format is 16 groups of letters and numbers. A typical line of four groups might copy as: IIR43 INW13 IAR45 IMW45. Each group is composed of three letters and two numbers. The separator "RS15" is sent at the beginning of each set of 16 groups.

Decoding details were not available in the first few weeks after launch, but when available can provide important data for those interested in monitoring the satellite's health.

Many parameters are measured, including power output, temperatures of various modules and voltage/current levels at important points in the system. The letters in each group usually signify the status of a system, while the numbers provide a related measurement. Simple equations are used to convert from the two-digit value to degrees C, volts, amps or watts.

Some European observers have heard transmissions that sounded like high-speed data. These transmissions from the satellite have not been at regular intervals and are likely activated by the ground command station RS3A.

Early Activity

The first reports of signals from RS-15 came from Europe. Oscar DJØMY monitored RS3A using CW and calling "CQ" in the transponder passband less than 12 hours after launch on December 26th. Oscar later made an SSB contact with a station in the Canary Islands.

U.S. contacts through the satellite were reported later between N2NRD and K6GZ. Others began hearing of activity through the new Russian hamsat and joined in to make contacts or study the orbit.

Those making contacts through RS-15 found that signals were not strong. The beacon on 29.352 MHz was much louder than signals in the passband. Observers were hopeful that the system was simply set for a low power setting on the transponder until check-out by ground controllers was complete.

As with almost all other new ham satellites, orbit determination was a guessing game. The best early element sets for RS-15 came from a ham and not NORAD. Ken N2WWD provided data for tracking programs that gave better signal acquisition and loss predictions than others.

Several sets of NORAD data were tested and posted to the Internet and amateur-radio CBBSs. About a week after launch one ham observed that, "I have now received over 20 some sets of KEPs for RS-15 to date from everyone and his brother, and none of them are correct . . . What gives?"

After many fit tests a set of elements will be defined and identified as those of RS-15. They will then become a part of the orbital postings from AMSAT to the Internet and packet-radio network. It took many weeks to sort out RS-3 through RS-8 when they were launched together on one booster in December 1981.

Working RS-15

Two approaches can be taken for RS-15 work. The first is to treat it like the other current RS-series hamsats and use simple antennas and gear. The second is to consider it as a vehicle for low-earth orbit DX.

The typical setup for working RS-10 will do well for RS-15. Using a 2 meter system capable of about 100 watts ERP (effective radiated power) coupled with a 10 meter receive system employing a dipole or ground-plane antenna, contacts can be made with relative ease. Operating through the satellite when it is near the horizon though will be difficult. Some of those low, horizon-grazing passes or brief moments at the edge for a higher-elevation pass can yield great DX for the properly equipped.

To put together a Mode "A" DX station, better antennas and some height are needed to get the most from RS-15. A good view of the horizon is necessary. A good DX station will have a three-element, 10 meter yagi at 30 feet or higher with at least a seven-element, 2 meter yagi just above it. A quiet 10 meter preamp and quality feedline also help.

To pursue DX via RS-15 the orbits must be studied. Passes should be checked from both the home location and the DX area of interest. Sometimes slightly sub-horizon passes can provide surprising results if conditions are right. Avid DX chasers may not even bother with elevation rotators.

Whether you put together the ultimate Mode "A" station, or just try your hand at casual contacts via the new satellite, it will be worth it. RS-15 provides another "easy-sat" for newcomers and more opportunities for fun contacts and serious satellite study for long-time enthusiasts.

Congratulations to the RS-15 crew in Russia and thanks for the Christmas present. 73

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Some Ham-Type Products

Every now and then I like to lake a look at some products that might interest readers ol this column. I don't do it very often, but every now and then the urge strikes me. I don't look at transceivers and other major pieces of equipment that *73* has covered elsewhere anyway, but I do look at minor equipment and things ol use to the workbench ham/hobbiest builder. This month we take a look at some of each class.

RF Shielded Boxes

At one time I loathed small RF electronic projects above about 75 meters because they were "too hard," but as I grew in confidence I learned a few things about RF construction (e.g. layout, grounding, shielding, etc.), and found that by following the rules, one can be as successful building RF stuff as at lower frequencies.

One problem that has always been something of a hassle, however, is the shielding that's required. One could leam layout and grounding, but shielding usually required a better box than I had. Most of the low-cost aluminum electronic hobbiest boxes on the market are OK for DC to the AM broadcast band, but as frequency climbs into the HF and VHF region problems begin to surface. What you thought was shielded "ain't." If you've read this column or my feature articles over the years, you will recall that I caution RF constructors to use the kind of aluminum box with an overlapping flange of at least 0.25", and a good tight fit. Many hobbiest-grade boxes on the market just simply aren't good enough.

Enter SESCOM, Inc. (Dept. 73-JJC, 2100 Ward Drive, Henderson, NV 89015-4249; 702-565-3400; for voice orders only, 1-800-634-3457; for FAX orders only, 1-800-551-2749). SESCOM makes a line of cabinets, 19" racks, rack mount boxes and RF shielded boxes. Their catalog, "Constructor's Hardware for the '90s," has a lot of interesting items for radio and electronic hobbiest constructors. I was particularly taken by their line of RF shielded boxes. Why? Because it seems that RF projects are the main things I've built for the past five years.

Photo A shows one of the SESCOM RF shielded steel boxes in their SB-x line. Note that it uses the "finger" construction in order to get a good RF-tight fit between the lid and the body of the box. Note also that the box comes with some snap-in partitions for internal shielding between sections. The box body is punched to accept the tabs on these internal partitions, which can then be soldered in place for even better stability and shielding.

At first, I was a little concerned about the material the boxes are made of—hot tin-plated steel. The tin plating makes soldering easy, but steel is hard on drill bits. I found, however, In experimenting with the SB-5 box supplied to me by SESCOM, that a good-quality set of drill bits had no difficulty making a hole. Sure, if you use old, dull drill bits, and lean on the drill like Attila the Hun, then you'll surely bum it out. But using a good-quality, sharp bit, and good workmanship practices making the hole, and there shouldn't be a real problem.

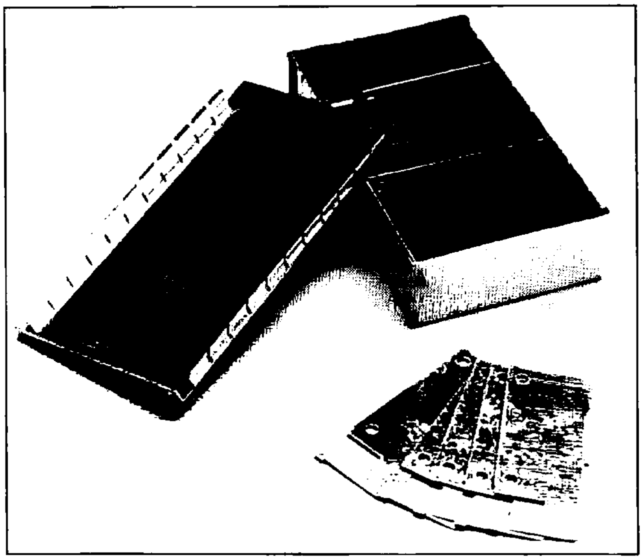


Photo A. SESCOM RF-tight hot tin plated steel boxes.

The boxes come in eleven sizes: 2.1" x 1.9" footprint to 6.4" x 2.7" footprint, with heights of 0.63", 1.0" or 1.1".

Prices range from $4.50 to $13.20 . . . which compare quite favorably with the prices of the better quality aluminum boxes that don't shield so well at RF frequencies.

SESCOM also makes chassis feedthrough capacitors that can be used to carry DC power into the boxes, as well as control lines, low-frequency signals and so forth (in or out of the box). Two models are offered: FTS-1 is a 1000 pF/50 WVDC solder-in type ($0.85 each), while FTSI-1 is a screw-in type of the same ratings ($3.50 each). Il you've priced screw-in feedthrough capacitors recently, you'li find out why they give them the fancy name "EMI filters" . . . a $6 price tagl The SESCOM prices are considerably bet-

Say You Saw It In
73 Amateur Radio Today

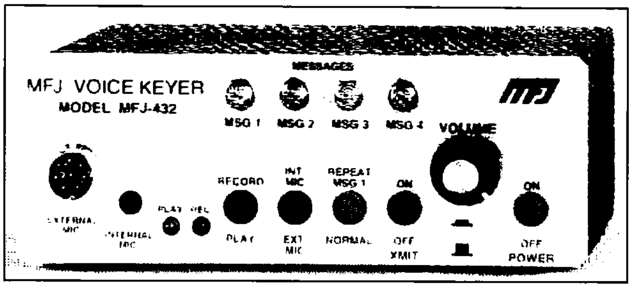


Photo B. MFJ Voice Keyer.

ter, especially for a guy like me who buys them by the 10-lot or score-lot (that's 20 of 'em for you who think "score" means something else).

Voice Keyer

The literature that comes with the MFJ Enterprizes, Inc. (P.O. Box 494, Mississippi State, MS 39762; voice 601-323-5869; FAX 601-323-6551; and, orders only, 1-800-647-1800) model MFJ-432 Voice Keyer (Photo B) asks: "Ever wondered what kind of tricks you could pull if you had a clone? . . . Now you can have a cloned voice with the new MFJ-432 Voice Keyer." With the Voice Keyer you can operate a long contest weekend without having your voice crack (instead of "CQ Contest . . . " you start sounding like "Ceeech koo context" after the first 12 hours). The Voice Keyer will store up to four messages of 20 seconds each. The messages are stored in an EEPROM, and will last up to 10 years without a back-up battery.

The Voice Keyer is inserted in the line between the microphone and the mike jack on your rig. Internal jumpers let you customize the Voice Keyer to your rig (Kenwood, Yaesu and ICOM configurations are supported).

The Voice Keyer costs $99.95. It has a built-in speaker for monitoring the messages off-the-air, and a jack for remote control operation. It operates off a 9-volt battery (not included) or from 110 VAC with the MFJ-1312B adapter ($12.95).

Morse Code Tutor

I know Wayne has bad-mouthed the code, but I'm a dyed-in-the-wool CW fan, and (although out of practice) got pretty good at it at one time. If you want to learn the code, either for an FCC examination or for the pure heck-of-it, then the MFJ-411 Morse Tutor (Photo C) might the "key to success" (I couldn't resist that pun, sorry). The MFJ-411 Morse Tutor allows you to learn code letters and numbers by association and relation, yet it also has a word recognition mode (nice for the current exam format). You can customize the sessions at speeds from 5 to 60 WPM, and with audio sidetones from 300 to 3,300 Hz. Either earphones or a built-in loudspeaker can be used. Like the Voice Keyer above, the MFJ-411 Morse Tutor will operate from 9 volts DC or 110 VAC with the same AC adapter.

New Books . . .

Recently I bought the latest *ARRL Handbook* and the *ARRL Antenna Book*. I believe that all hams should have a relatively recent *Handbook* available, so buy one every two or three years. Similarly with the *Antenna Book*. This year, the *Antenna Book* comes with a software disk that has some antenna software that runs on IBM-compatible computers. If you haven't seen these books, they're both winners. Contact "Uncle Wayne's Bookshelf" for details and prices . . . or see a local ham dealer. Note: If you have a technical book dealer in your area, most of them carry these books even though they are intended for amateurs . . . it seems that a lot of pros use them too.

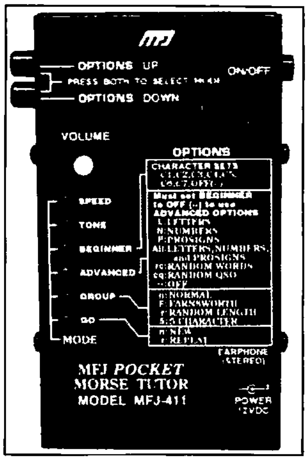


Photo C. MFJ Morse Tutor.

Every writer dreams of having their book come out as a movie. My tech books never come out as movies, but HighText Publications, Inc., who publishes my book *The Art of Science*, adapted material from the book and added a very powerful CD-ROM multimedia product. The new product, including a book and the CD-ROM, is called *A CrashCourse in Statistics*, and is available from booksellers at $29.95, from Uncle Wayne's Bookshelf, or from HighText directly (125 North Acacia Avenue, Solana Beach, CA 92075).

Number 15 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

Once again, I turn to you, the readership, for the seed of this month's column. I have told you before, your letters are read, your E-mail is digested! Here is the latest offering.

Subband Info for a New Ham

Don Young N2SLS of Cranford, New Jersey, drops me a line via America Online which says:

"As a relatively new ham, I've been interested in trying RTTY, packet and Pactor for their obvious communication advantages. Thus, I assembled VHF and HF packet systems via a KAM Plus and a Macintosh SE, running Hostmaster Mac purchased from Kantronics. The hardware seems to operate fine, and I've easily connected to a local packet BBS for DX clusters. However, the newness factor, combined with a shortage of time, has caused me to achieve little or no success on HF. The main stumbling blocks seem to be: locating the various subbands where these modes are located, and then distinguishing one mode from another to achieve a contact within a reasonable time (<1 hr). The latter seems to be strictly trial and error, and my ear hasn't yet grown accustomed to RTTY vs. AMTOR vs. packet vs. Pactor, etc. Could you provide more info on the subbands, and a source of info on how to distinguish various modes so I waste less time just tuning around and trying to figure out what I'm listening to?"

Well, Don, you ask some questions that many a new, or older, for that matter, ham has asked. Let's try to look at what you have posed, and see if we can't help others with the information, as well.

The station you have assembled is a good one. The newer multimode controllers, such as the KAM Plus you have, do a fine job of decoding the various digital modes. In truth, having assembled the hardware, you have conquered the most challenging task facing the typical amateur.

Although the frequencies of packet communications are well established on VHF, with 145.01 MHz being one of the most common, things do not appear to be so well organized on the HF frequencies. Unless someone sends me a listing, my advice would be to scan around the RTTY neighborhood of the HF bands, particularly 3620 kHz on 80 meters and 14.080 MHz on 20 meters, and *listen!*

Listen for what? OK, as best as I can put this into print, it goes like this. Classic RTTY has a deedle-deedle-deedle continuous sound. Certain specific sequences, such as "CQ" or the standard "RYRY" test signal, have readily identifiable sounds, which you will recognize as you gain experience. AMTOR and Pactor have very similar sounds, since they are very similar systems, best described as brief pulses of RTTY-sounding signals. Packet is rougher, and almost sounds like tuned static, being sent in bursts. If you are lucky with these latter methods, you might hear the receiving station's signal acknowledging the sender, with brief response packets.

Now, this is, of necessity, a rough—very rough—description. While an experienced ear may be invaluable for identifying these signals, a little bit of hardware doesn't hurt, either. While I am not aware of whether or not the KAM can identify signal types, the AEA PK-232 does have a signal identification and acquisition mode, called SIAM, that can listen to and identify many different signal types. Once again, something tells me that if I am wrong, I'm going to hear about it!

On the other hand, many of you continue to look for that "ideal" program to interface your multimode controller with your computer. To wit, I offer the following two items.

LAN-LINK

LAN-LINK version 2.32, the latest version of Joe Kasser's monumental terminal controller program for DOS-based computers has arrived, and boy, it is something!

LAN-LINK works with just about any controller, from the simple PK-88 to the latest PK-900 or DSP-2232. Its start-up modes are fully customizable, and its dBase-compatible logbook can serve as the source of station information or can be used to help control contact features. There is even a computer-based guide, ELMER, which uses artificial intelligence to help you through various tasks. With an assortment of 10 brag tape files available for each of six communications modes, operating digital modes with LAN-LINK may reach new heights of sophistication.

Various commands may be handled through menus, Alt-key combinations, or function keys. This allows a degree of personalization of the program rarely possible with most communications packages. There is full support for packet cluster, bulletin board, and other such techniques. The logbook is even operative as a contact checker for contest work.

As you can see, this newest version of LAN-LINK may be just the answer for the ham looking to operate a TNC or multimode controller from the DOS prompt. It is a significant update to previous versions, and its appearance on the scene is much appreciated.

PacketPet Lite for Windows

For those of you who prefer the Windows environment, Chuck Harrington has released a fully-functional version of his PacketPet Lite for Windows that is one sharp package, also!

Containing most of the features of the full commercial program, PacketPet Lite for Windows is a full-featured controller for most TNCs and multimode controllers, operating as a full-fledged Windows application. There is extensive help, provided as a standard Windows Help file, as well as context-sensitive help with a mouse click, and detailed information for using COM ports in non-standard fashions, essential if your computer has "extra" devices, such as CD-ROM drives, scanners, or sound boards.

Chuck notes that PacketPet Lite requires some kind of hardware TNC, and will work with most of them! Host or KISS Modes *are not* required, and even the *retail version* of PeT, PacketPeT For Windows, is able to implement its advanced features without resorting to the restrictions of Host Mode.

PacketPeT can send and receive two types of graphics that are frequently seen on packet networks. The first graphic, sometimes known as a "brag," is a simple text file that contains characters of the IBM OEM character set arranged in such a manner as to appear to be a picture.

The second type of graphic that has recently started to appear is an ANSI Graphic. These are in color, and contain control codes to control text and background colors. Registration of the shareware program is required in order to enable the display of ANSI graphics.

Now, I woudln't tease you about these two programs without providing a way for you to get them easily enough, so surely I have done just that. These two programs make up the nucleus of Disk #8 of the "RTTY Loop" Software Collection. I can't tell you at this writing what will fill out the disk, but I'm sure I'll find something of interest. Feel free to drop me a self-addressed, stamped envelope, or a piece of E-mail, for a listing of all that is available. Those of you who are anxious to get started can just send me the standard $2 in US funds, a self-addressed stamped disk mailer for return, and a 3.5" disk, and I'll fill it and return it to you.

Otherwise, I look forward to your comments and questions every month. Send your missals to me at the above address for SnailMail, or on Email via CompuServe (75036,2501), Delphi (MarcWA3AJR), AOL (MarcWA3AJR), or Internet (MarcWA3AJR@aol.com). Next month, I think I might have an easy way to get on the air! No fooling!

QRP

Number 16 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

This month I have some rather unusual circuits for the QRP builder. Some are brand-new, while others are improved versions of old favorites.

Have you ever needed a minus supply for a project that runs from a battery? In the past, you could add a second battery, but that always proved to be a pooper. With projects running from an AC power source, generating a minus supply voltage was easier, but still required a center-tapped transformer. Here's a circuit that only requires two capacitors to generate a negative supply: the CPA7660S by Harris. Digi-Key carries this 8-pin DIP IC. It's about $3 or so.

You input a positive voltage and you get a negative voltage out. It really is that simple. I've used a 555 timer running in astable mode and a voltage multiplier combination of zener diodes to generate a negative voltage in the past. But by using this chip, it's oh so easy. So, the next time you look at a CW filter requiring a negative supply, reach for a CPA7660S.

High-Side FET Driver

I've been using more and more power MOSFETs in my projects lately. From RF amplifiers to high-side switches, the power MOSFET is quite a device.

However, applications requiring high-side switching all require some sort of charge pump, and the associated components to turn the gate on and off. Again, as in the negative power supply, I've used everything from 555 timers to a section of a LM324 op amp. They've all worked, but whoa! All those parts to do such a simple task.

Well the answer is again a special 8-pin DIP IC made by Linear Technology. It's called an LT. The LT is avaiable from Digi-Key for about $3, too. A surface-mount version is also available.

The LT has some very special features hiding inside. One is the overtemp shutdown. When this pin is pulled high, the output is pulled low and will stay that way until the overtemp is pulled low and then the chip resets. Normally, this pin is tied to ground.

The output of the charge pump should be connected to a high impedance load. It's very easy to load the charge pump down so its output nears the supply voltage.

Connected as shown in Figure 1, pulling the input lead high will cause the output to pop up to about 28 volts, depending on the supply voltage. The enable pin is normally held low, but you can tie the input to ground and use the enable pin as an inverted input. The status pin is normally not used. It's an open collector switch that will go low when the overtemp shutdown is active.

Unusual to this chip is the drain sense pin. By sensing the voltage drop across a resistor in the drain lead, you can come up with a clever over-current protection. You can even add a delay to this line so it will ignore sudden high current loads such as a cold light bulb turning on. If this pin is not used, tie it to the VCC pin, 8. What it used to take over 30 parts to do can now be done with one chip. Amazing!

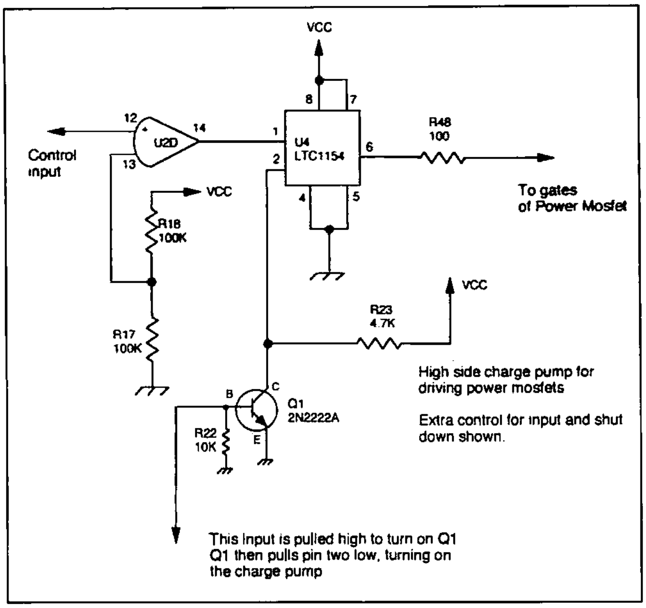


Figure 1. A high side MOSFET driver with control circuitry.

Pulse Maker

Ever have a need for some good ol' fashion' square waves? See Figure 2. Here is the notorious 555 timer IC put to good use. This circuit makes square waves that are very good, with nice rise and fall times. By changing the values of the two timing resistors, you can change the duty cycle of the oscillator. With the values shown, the duty cycle is about 50 percent. This is one of my favorite building-block circuits. It's great for testing digital circuits.

DVM

I've given several examples of expanded voltmeters in this column. However, here is a circuit that will display voltage digitally. (See Figure 3.) It uses two common ICs and a handful of parts. I would like to take the credit for this one, but I can't—Dick from S & S Enginnering came up with it. I don't have a PC board layout for this circuit, but may work on one if there is enough interest. Digi-Key carries all the parts you'll need. Assembly is best done on perl board, using point-to-point wiring.

Dayton '95

Yup! It's that time of year. Again, the town of Dayton, Ohio, will be overrun with QRPers. We'll again be staying at the Days Inn South.

What started out last year on a whim grew into a full-blown banquet on Saturday night. We had a huge turnout and gave away several rather slick door prizes. Nope, we're not talking a coffee mug or two, but MFJ QRP rigs, solar panels, assorted kits and other goodies.

Of course, there's the usual storytelling and those great DX catches to hear about. But, it's also a time to get to see some of the newest stuff coming down the road. Last year we saw

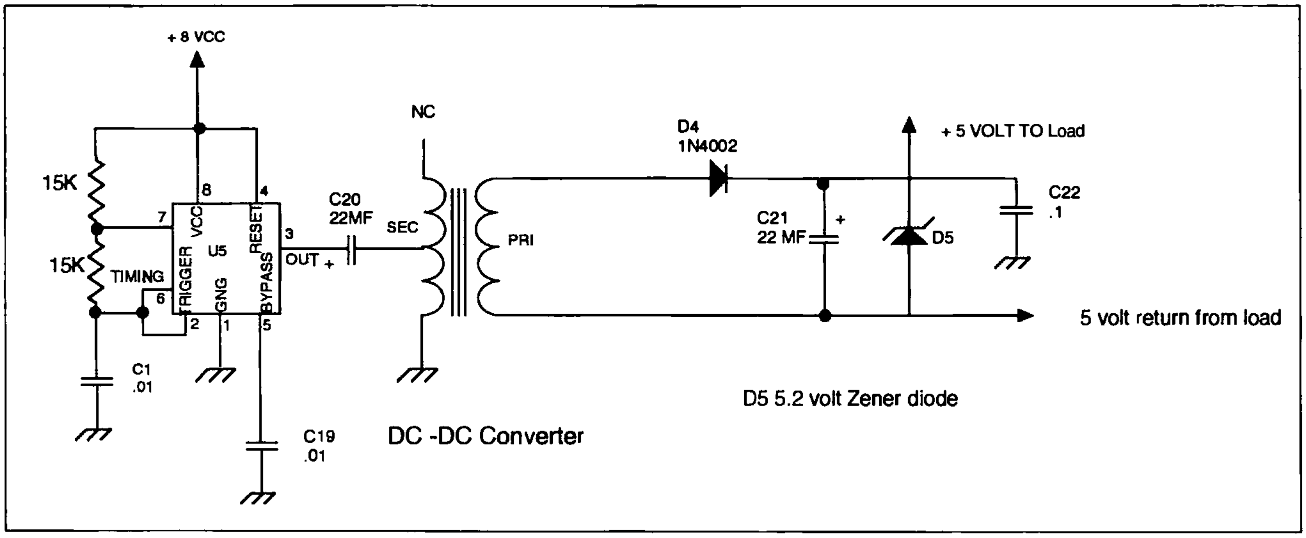


Figure 2. A DC to DC isolated power converter.

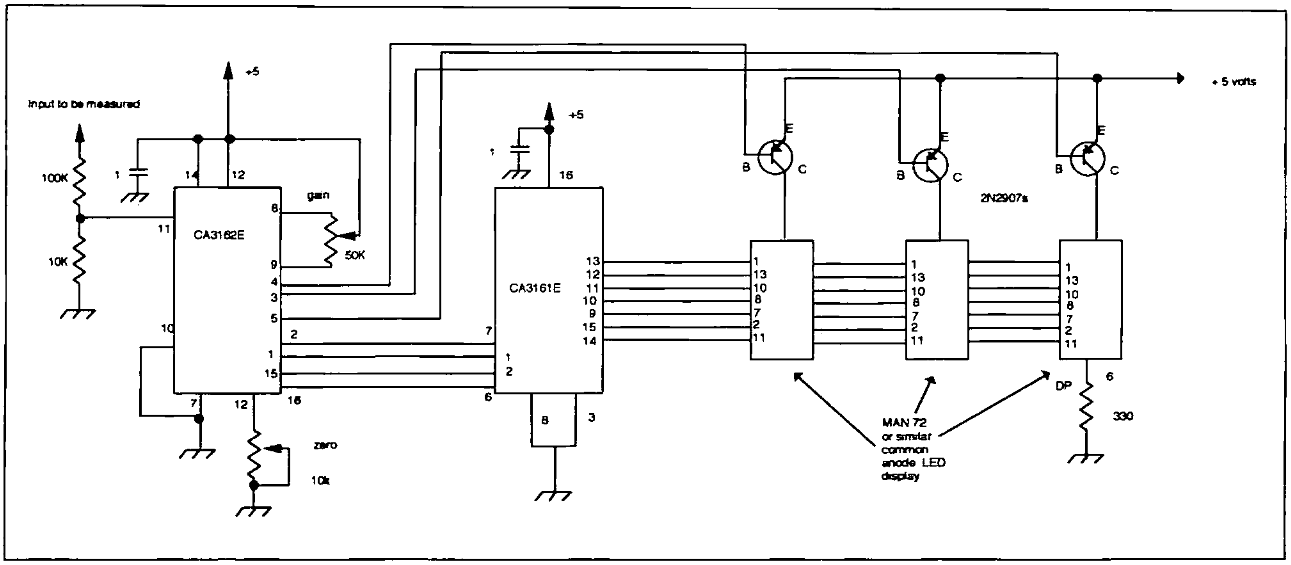


Figure 3. A simple 3-digit voltmeter.

the ARK-4, the Norcal, the New England 40-40, and goodies from Radio Kit as well. This year there'll be even more!

We'll have forums and a sign-up booth inside the arena. QRP clubs from Michigan QRP, G-QRP, QRP ARCI, QRPP, New England, and more will be there signing up new members. It's a lot of fun, even though it has rained the last several years. I'll be there as usual, and perhaps give a talk this year as well on QRP.

It's time to get going if you want to make the trip. Send a check for one night's stay, made out to the Days Inn, to Myron Kyole, 1101 Miles Ave. SW, Canton, Ohio, 44710. You can call Myron at (216) 477-5717. Be sure to include an SASE when sending your check to Mryon. DON'T WAIT! Rooms went fast last year and there was a long waiting list for canceled rooms.

Number 17 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

Multiple Foxes = More Fun

"It's 'hide and seek' for kids of all ages, with radios!" That's a one-sentence explanation that passers-by often receive when they ask what's going on at the starting point of a hidden transmitter hunt. Of course, these radio direction finding (RDF) exercises, which are also called foxhunts or T-hunts, have more important purposes, too. They prepare us to track electromagnetic interference, bootleg stations, and even aircraft and vessels in distress. But mostly, we're out for the fun of it.

Until a few years ago, no one in my area considered having more than one hidden station per hunt. After a full evening of hunting one T, few teams were ready for more. But hunting capabilities vary. A fox that takes five hours for one team to find might take only two hours for another.

On a couple of occasions, a team that found the fox quickly would go away and put out its own transmitter for other early finders to track. Within months, some hiders were putting out one or more low-powered extra T's as optional targets for early finders.

To this day, some RDFers continue to scorn the idea of mobile multiple T-hunts. "If you can hide one transmitter really well, that should be enough," they say. Others have come to like the challenge of trying take bearings on several targets at a time.

Photo B. Can you find the transmitter in this picture? The shirt-pocket T by Don Lewis KF6GQ is in a 3-3/4" x 2-3/8" x 1" plastic box with RCA phono jack for your antenna.

For the Los Angeles area 2 meter Pathfinder Saturday night hunt last November, Byon KD6BCH and Lara KD6AYO Garrabrant padlocked five half-watt ammunition-can transmitters in various places within a two-mile circle in the city of Torrance. On/off timing of each was random. All were on the same frequency. Each generated its callsign identification in MCW and sent a distinctive audio tone pattern. Only one T's signal reached the starting point 32 miles away. It was atop some children's playground equipment in a hilltop park. The other four were in public areas such as schoolgrounds and horse trails.

Of the 13 teams that started, eight found all five foxes. Elapsed times ranged from four to seven hours. This monthly hunt is normally scored by odometer readings. In this case, the winning team was determined by the lowest total mileage from start to the last transmitter. They could be found in any order. For even greater difficulty, Byon could have required the transmitters to be found in numbered order.

Make A Weekend Of It

Southern California's famous All Day T-hunts now feature multiple foxes whenever the hiders so choose. As regular readers know, the "All Day" title is a misnomer; these hunts frequently last 24 to 36 hours. Hunters start from a hilltop in Rancho Palos Verdes at 10 a.m. Saturday, remembering that the boundaries include the entire continental USA, and that the record distance for a 2 meter hidden T is 344 air miles (Photo A). Lowest total mileage wins this hunt.

The apparent holder of the record for greatest number of T's hidden on an All Day hunt is Don Lewis KF6GQ, who has been a part of the Southern California RDF scene for over 20 years. On the weekend before last Halloween, he and his family, along with Mark Harris KD6LAJ, scattered nine emitters in the Holcomb Valley, all on the same frequency. This area is north of Big Bear Lake, at about 8,000 feet elevation, in the San Bernardino Mountains, about 90 miles from the starting point.

"The T's were all within about a 2-1/2 mile radius from our campground in the center of the valley," KF6GQ told me. "Four transmitters had KD6LAJ's call on their CW ID, numbered 1, 2, 3, and 4. In addition, there were five shirt-pocket size T's with my call on them, numbered 1, 2, 3, 5, and 17. We deliberately tried to make it as confusing as possible. That's why tha numbers were similar and they sounded the same except for the CW IDs.

Photo A. "No rules, boundaries, complaints, or clues" is the motto of many intrepid Southern California T-hunters. Magnetic door signs to proclaim this have been designed by Cathy Livoni KD6CYG and procured by Peter Ernster WA6TQQ. Several teams' vehicles now sport them, but it's too soon to tell if the number of pullovers by curious law enforcement officers has been reduced.

"Three KD6LAJ foxes ran about 2 watts each on separate hillsides around the valley," Don continued. "They went on and off at exactly the same time. The one you could hear at the start ran into a long beam pointed southwest. The three T's antennas were pointed toward each other. Furthermore, each of the three was situated so you had to approach on its beam's backside, where the T's from across the valley would give stronger signals.

"At the beginning of the hunt, we told the hunters that no matter how many transmitters they tried to find they must be sure to find KD6LAJ #1, the only one they could hear at the start point, in order for their mileage to count. We would determine the winning team by mileage and total number of T's found.

"Because the three KD6LAJ foxes were synchronized, it drove everybody crazy. As soon as they would get close to one, they would have to go to the backside, with either a hill there or the back of the antenna—something to cause its signal to become much weaker.

"There were five teams that claimed afterwards to have found KD6LAJ's #1. But as it turned out, only two found it, because besides the real T #1, there was a decoy. The real antenna was down in a bush on the southwestern facing slope of a ridge line. To get to it, you had to come up the back side, over the top of the ridge and then down toward it. In plain sight on top of the ridge was a shiny antenna on a mast and what appeared to be a transmitter.

"Actually, this was a transceiver with the transmit light wired to work in reverse. It lit when it received the real T's signal. It was only about four feet from the real antenna. Hunters saw the light come on and the meter go up, and thought it was the real T. They should have checked it with their sniffers, but three teams just signed the check-in sheet there and left. Two other teams were lucky because they got there at night, didn't see the dummy, and sniffed out the real T.

"It was funny because the next morning as they were driving home, some of the teams were talking on a repeater, describing what they had found. They suddenly realized they were talking about two different setups for KD6LAJ #1. We let them go on and on before we confessed to them. One other hunter didn't find out he was fooled until the next weekend.

"The fourth KD6LAJ transmitter was at our campground. It had different timing and had a very strong signal in the hills, so we could get the hunters into the campground and greet them at least once. The hunting teams worked really hard—the last one quit at 9:30 Sunday morning.

"My boys helped hide the five KF6GQ milliwatt-level transmitters. One was tied to a barbed wire fence. Another had an 'invisible' beam made of piano wire in a tree. Nobody found three of them, yet they were all copyable at the campground.

"One was atop a ridge on what we call 'The Road of a Thousand Forks.' As soon as you enter it off the main road, it splits. And each fork goes into another Y, and so on. To get to the right ridge, there was one fork with chunks of big rocks on the road. I suppose you could have gotten up that road with four-wheel drive. But if you went a half mile farther to the east, there was a real easy fork that went up and then across the ridge to where we hid a mini-T."

If One Is Good . . .

Imagine the RDF fun your club could have with a few low-power mini-T's like these! Unlike higher power transmitters that need large battery packs, foxes in the 3 to 30 milliwatt range can be smaller than a pack of cigarettes. They will run for days on

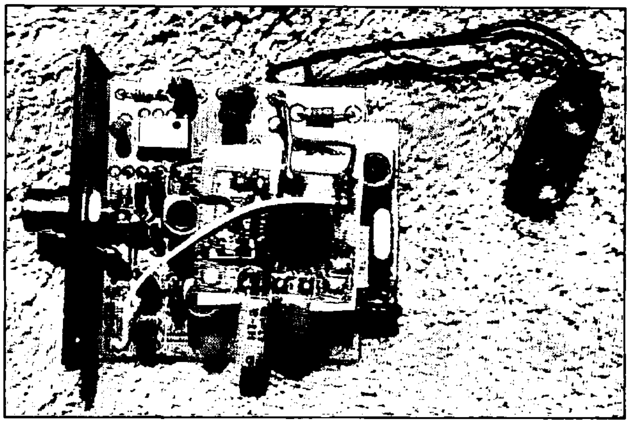


Photo C. A stamp-sized audio board sits atop the 2-1/8" x 2" RF board in the HT-101. There are about 30 components on the RF board.

throwaway alkaline batteries.

Put one or more mini-T's near the main fox at the end of your club's next T-hunt for added fun. Or scatter a bunch of them in the park during your club's next picnic, and encourage the kids and adults try to find them using just their handhelds.

Home-brewers can find information on how to build low-power foxes in my book.* For those who prefer to let someone else wield the soldering iron, KF6GQ is assembling and selling his shirt-pocket T's (Photo B). Don designed his HT-101 around the Motorola MC2833 FM Transmitter IC. His double-sided glass epoxy circuit board includes a voltage regulator and CMOS 555 timer (Photo C). The oscillator is crystal-controlled at 1/12 the 2 meter output frequency.

Modulation comes from a second board with an analog storage IC. It holds 10 seconds of audio indefinitely, even when unpowered. Don programs the station ID in either MCW or computerized voice. Unfortunately, he did not design his unit to be easily field-programmable, but it is possible for users to change the audio message by feeding 5-millivolt audio into the sub-board and jumpering some pads on it.

You cannot get an accurate power measurement on a milliwatt-level transmitter with an ordinary wattmeter. I hooked the HT-101 to a dummy load, viewed the output voltage waveform on a sensitive 275 MHz bandwidth oscilloscope, and computed power with Ohm's Law. KF6GQ promises 5 milliwatts minimum. I measured 9 mW on one I tested. It drew 33 milliamperes from a fresh 9-volt battery when transmitting, 560 microamperes when idle.

"I used tantalum capacitors for the on/off cycler, so I make no claims for timing accuracy," says KF6GQ. As supplied, the RF is on for six seconds and off for about 25 seconds. You can change the value of a fixed resistor to get other ratios.

With a typical 20% duty cycle, you should get about 36 hours operation before the battery dies. RF output voltage decreases in proportion to supply voltage. At 4.5 volts, power is down by a factor of four. The audio chip works normally down to about 4 volts. It is easy to tell when the battery voltage goes below that, because the audio pitch gets lower and the ID cycle stretches out.

The MC2833 IC has a very wide temperature range. When I sprayed Chemtronics Freeze-It directly on the chip, the HT-101 output power didn't budge. "When we hid in the mountains in October, it got so cold at night that my dog's four-inch-deep water bowl froze solid," says KF6GQ. "Two T's died, but it was because of the batteries, not the transmitter." Carbon-zinc batteries work poorly in the cold, so be sure to use alkaline batteries under these conditions.

GQ Enterprize, Don's company, sells the HT-101 only as a wired/tested/programmed unit, not as a kit. The price is $79.95, plus $3.50 shipping/handling. It is crystalled and tuned for 146.565 MHz, a popular fox-hunt frequency in many cities. For another frequency, add $10 and allow three weeks for procurement of your crystal. Checks should be made out to Don Lewis. Of course, here is the usual disclaimer: Neither I nor *73 Amateur Radio Today* warranty this offer.

For more information on the HT-101, send a self-addressed stamped envelope to GQ Enterprize, Suite 524, 129 East Colorado Boulevard, Monrovia, CA 91016. (By the way, this return envelope courtesy is greatly appreciated when you write to *73*'s authors, too.)

Watch for reviews of other new fox-hunt transmitters in upcoming columns. Please let me know of any new RDF products you encounter. Tell me what you like and dislike about them. Write to my California address at the beginning of this column, or send electronic mail to me via the Internet (joemoell@cup.portal.com) or at CompuServe (75236,2165).

* *Transmitter Hunting—Radio Direction Finding Simplified,* a 323-page illustrated text on RDF by Joe Moell KØOV and Tom Curlee WB6UZZ (TAB/McGraw Hill #2704), is available from Uncle Wayne's Bookshelf.

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

Surplus VHF Downconverter

This month I want to cover a simple 1240 MHz ATV converter that can be constructed out of a cable TV converter. These units are electronically tuned by a DC voltage rather than a mechanical adjustment. They are starting to show up on the surplus market both used and new. This unit can cover frequencies from low VHF to about 400 MHz, depending on the model you obtain. A used TV or VCR tuner is also suitable but I could not cover all the variations you might run into. What I am describing is a unit that we obtained and will make available; it should be similar in operation to other units and the conversions covered should be similar as well.

What sprouted this idea was of course, the prime mother load of all surplus material that was just sitting in front of Kerry N6IZW and myself. You don't look a gift horse or any other critter in the mouth before you take advantage of good fortune; we made arrangements to pick up the whole load. On close examination, these units, being new, would be suitable for many different RF amateur conversions. We knew that we would make good use of this material.

The first step in the conversion process was to draw a basic block diagram and determine the operating voltages required to put it in operation. See the system block diagram shown in Figure 1. (In this simple test circuit I used a bench supply of +20 volts and wired in a +5 volt regulator for the prescaler chip.) We used reverse engineering to develop this schematic. The specifications of the tuners are as follows. The tuning range of the converter was from 50 MHz to just over 400 MHz. The primary IF output was TV channel 3 or 4. The tuning between TV channels was done electronically with a varactor diode to tune the voltage-controlled oscillator (VCO). This was accomplished in one range, 50 to 400 MHz, or 2 volts to 20 volts on the "VT" line. The output of the VCO feeds a mixer and a Toshiba frequency divider chip internal to the tuner. This divider chip allows the RF VCO frequency to be divided in frequency to a much lower frequency for RF readout on a counter or processor (PLL) control.

In the surplus lot of tuners that we picked up there were three different models. Under close examination the basic circuitry is all the same but minor changes exist within each one, making them somewhat unique. The major differences relate to the Toshiba divide-by chip. In model 113 the divide step is 256; in the 151 it is 64; and in the last unit, 333, it is 128. Knowing the divide-by ratio is only important when you want to know what the VCO frequency is.

For instance, if you have a control voltage of 9 volts on the (VT) voltage tune line this should represent a frequency of about 788 MHz, according to the VCO voltage/frequency chart in Table 1 (unmodified). By connecting a low-frequency counter to the prescaler (PS) pin this can be confirmed. All you need to know is the divide-by ratio of your tuner; so let's assume it's 256. In this case you would read with 9 volts on the VT line, a frequency of 3.078125 MHz. Of course the reverse is also true: Read the prescaled frequency and multiply to determine the LO frequency.

This PS output can be used with a low-frequency counter to set frequency or, if we get our act together, an upgrade in the form of a processor (PLL) controlling frequency to exactly the frequency we desire. We will update you on that circuit development next month. In the meantime let's get back to the rest of the tuner's circuitry. After the mixer we have an IF amp at 570 MHz, which feeds the second mixer. The second conversion oscillator runs at about 674 MHz and mixes the IF to about 60 MHz or TV Channel 3.

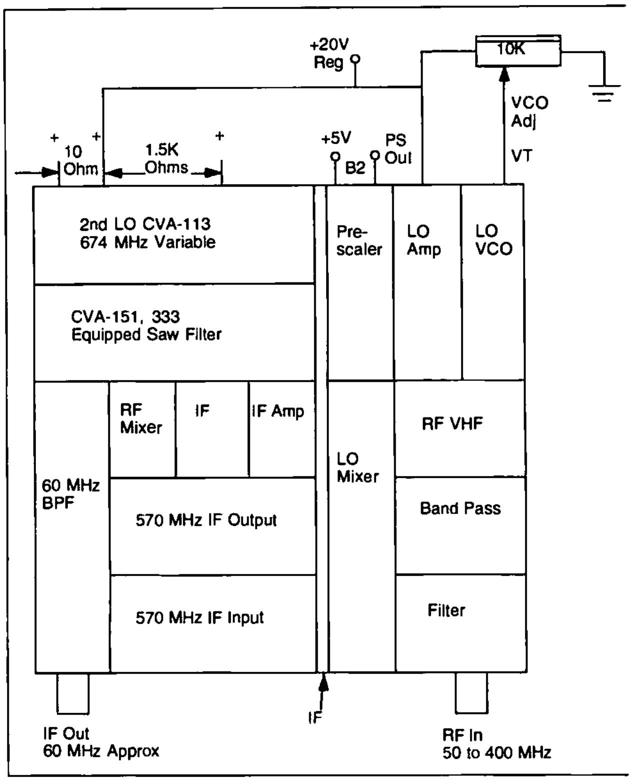


Figure 1. Block diagram of CATV-type downconverter.

Conversion to 1240 MHz ATV

In the simplest of conversions, the local oscillator in the CATV tuner is used to supply the LO for an external mixer. We connected a surplus amplifier for RF amplification to complete the converter package. There ar several variations to this scenaric you just pick the variation that applie to your requirements. The reaso for going to an external mixer is thε the original CATV mixer works we with high level signals from a CAT line, something we don't have the lux ury of having. The SRA-11 is a bette mixer, giving lower conversion los and more sensitivity to this systerr See Figure 2.

For the RF amplifier for the syster we found a unit that works well ε 1240 MHz without modifications to it circuitry. The amplifier in question ex hibits about 30 dB gain with a modes

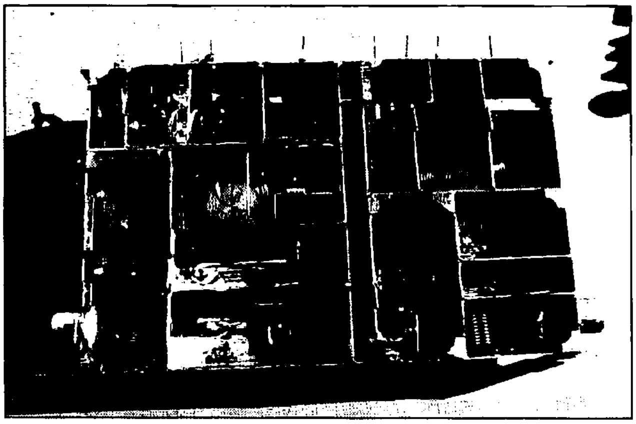


Photo A. CATV Model 151 tuner (second VCO adjustable); orientation of the coax connection at the bottom same as in the block diagram.

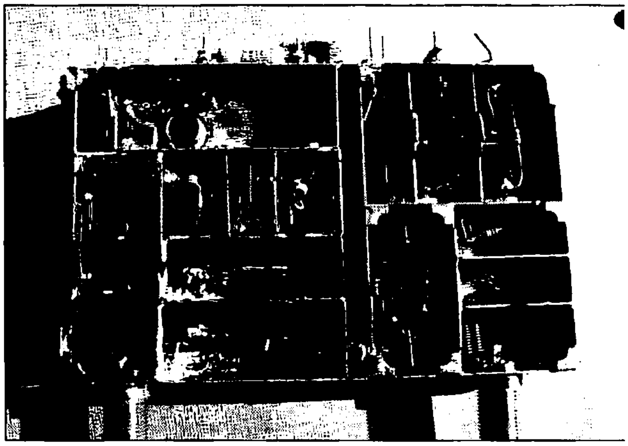


Photo B. CATV Model 113 tuner (second VCO uses SAW filter); orientation of th coax connection at the bottom bottom same as in the block diagram.

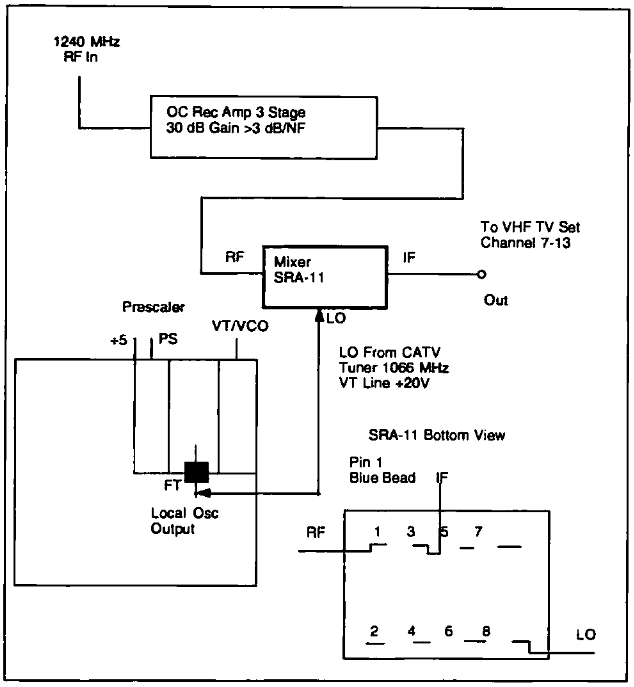


Figure 2. Diagram of 1240 MHz ATV converter using local oscillator (VCO) of CATV converter.

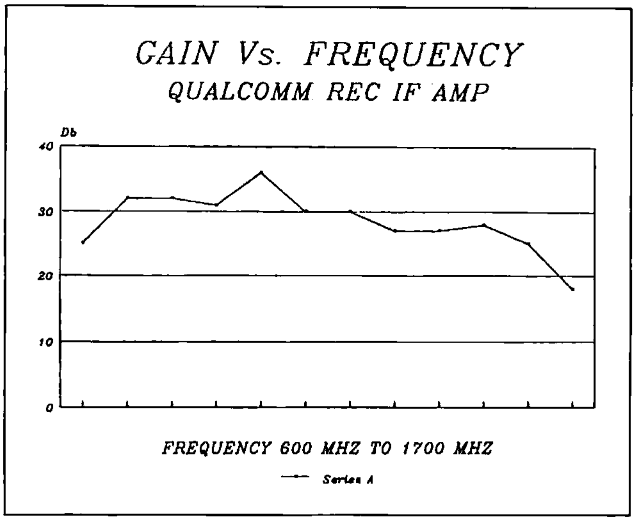


Figure 3. Gain vs. frequency of Qualcomm receive IF amplifier used as the RF amplifier. Operation from 600 to 1700 MHz with a noise figure of 2 dB.

noisa figure of about 2.5 dB. This amp is in fact a QUALCOMM IF amplifier that functions well as an RF amplifier. See Figure 3 for the gain vs. frequency operation of this amp. I have a quantity of these amplifiers and will make them available with the CATV tuners. Or you can roll your own amp and CATV tuner together to put this converter together.

Well folks, this is the basic project and it works well for ATV reception. The prototype construction by Art K6UQH proved out the basic concept. We would have gotten there ourselves but Art was motivated and did the modification. I was still drafting the schematic and mechanics of the project at that time. Initial tests in the San Diego area were made using the Mt. Palomar ATV repeater and the WA6VLF ATV repeater, with very good results.

Art placed his RF amp at the rear of a helical antenna. DC power was supplied up the coax for the amplifier. The remainder of the equipment was located at the TV receiver. This unit did use two RF amplifiers, a small preamp at the antenna and the Qualcomm amplifier, in addition to several bandpass filters to limit frequency response to 1200 MHz ATV.

First-Cut Modification

In the converter that Art K6UQH modified he used the VCO of the tuner and an external mixer coupled with the surplus receive IF amplifier serving as the RF amp. In the initial tests with this system Art was able to copy, from his QTH in Escondido, a video signal from the Mt. Palomar ATV repeater. Art used a workbench TV set on VHF Channel 7 for reception. Needless to say this was a no-frills converter that was functional and inexpensive to duplicate—prime goals in any project; soft on the pocket.

Let's get into the meat and potatoes of this conversion and cover each aspect towards completion. There are several different twists and turns you might take in your own ATV converter's development. Basically, it all turns into the same conversion with different twists. The twists relate to the level of complexity you are willing to delve into as each add-on or development requires more circuitry.

Let's for starters assume the minimum circuitry for a functional 1240 MHz ATV receiver converter system. The local oscillator frequency for the simplest converter is the IF frequency minus the RF frequency. In this case we will use TV Channel 8, which is an IF frequency of 180 MHz. Full video occupies 180 MHz to 186 MHz, 6 MHz wide. Now, 180 MHz (IF) minus 1240 MHz (RF) = 1060 MHz (local oscillator frequency). On all of the tuner models this frequency can be derived by applying a regulated +20 volts to the "VT" line of the VCO. See Table 2.

The VCO output is tapped out with a small coax lead of RG-174 (mini coax cable) where the input of the VCO previously fed the mixer. (Disconnect the capacitor from the mixer center-tapped ferrite coil and tie the coax to the capacitor. This same coax cable now connects to the LO port of an external mixer.) SRA-11 mixers from Mini Circuits Labs have very good performance to 2000 MHz; we used one of these in the first prototype. The IF port of the SRA-11 mixer is terminated in a 3 dB pad that is used to feed the TV receiver via a coax to a 300 ohm balun; or by coax directly, depending on your TV set's configurations. The pad is used to provide the IF port with a good termination.

The TV receiver is set to Channel 8 to receive the 1240 MHz ATV signal. Use Table 1 for other frequency IFs to suit ATV requirements in your area, and adjust accordingly. The Qualcomm receiver IF amplifier is connected to the RF port of the mixer and serves as the new RF amplifier. This amp is hot out of the shute without modification. The amp has about 25 to 30 dB gain at 1240 MHz, with a noise figure of about 2.3 dB. It's not the ultimate but, as I said, it makes a very hot RF preamplifier for this receiver that is ready-made.

You say your ATV frequency is something other than 1240 MHz? Well, if it's higher in frequency, switch the TV set channel selector to a higher TV channel, say 10 or 13. Each channel number increment adds 6 MHz to the RF frequency of operation. Any instability of the VCO is taken care of by the TV AFT circuits. A filter should be used before the RF amplifier but a

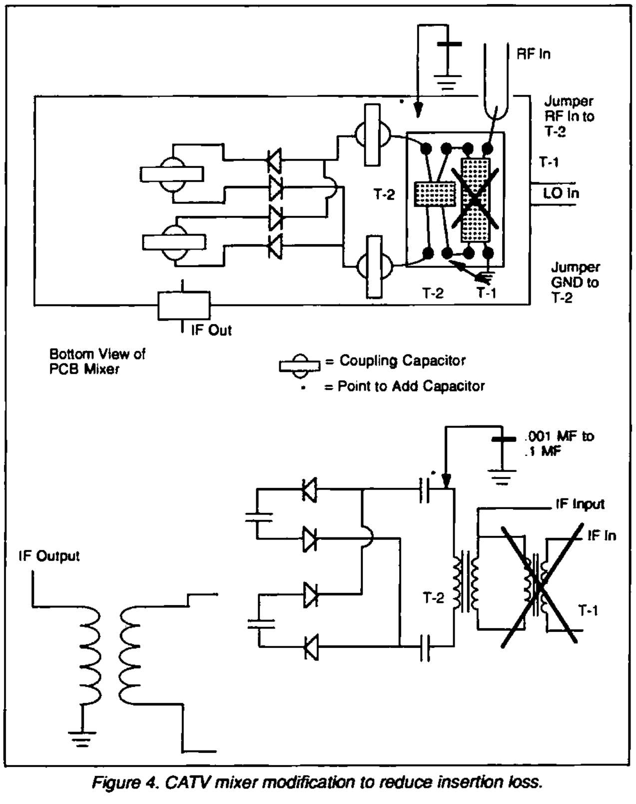


Figure 4. CATV mixer modification to reduce insertion loss.

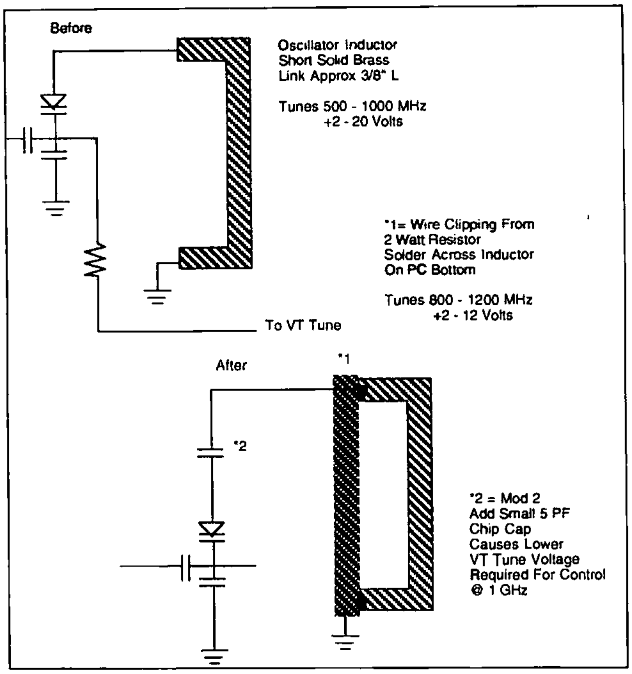


Figure 5. CATV Oscillator Modification to increase frequency of circuit and lower "VT" tune voltage for control of circuit from 12 volts vs. 20 volts unmodified.

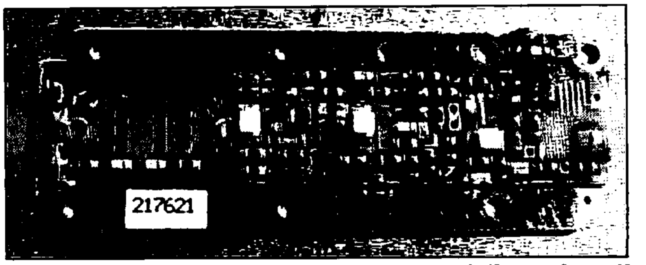


Photo C. Qualcomm IF amplifier, 600-1700 MHz, about 2.3 dB noise figure, 2" long by 3/4" wide.

"poor man's filter" could be the antenna. For best rejection to cellular and other services a filter is best. The filter should limit the input signals to just the 1200 MHz band before amplifying in the wide bandwidth (600-1700 MHz) of the Qualcomm receiver IF amplifier. I won't get into filters here as you can find several designs in most any ARRL *Handbook* for 1296 MHz.

The second modification, which will be covered next month, is to modify the VCO higher in frequency, allowing a lower control voltage "VT" with 1060 MHz. For those willing to follow this mod the rewards will be crystal-controlled PLL VCO stability. Before you enter this modification you need to know that the VCO stability is not critical, like trying to pick out a 5 kHz segment as you are tuning in 6 MHz video channel segments, making stability not a key parameter.

The VCO is modified in either case (PLL or manual control) to provide better higher frequency operation with a lower "VT" tune line voltage. See Figure 5. I placed a wire clipping (0.375" long) from a 2 watt resistor across the oscillator's tank circuit link inductor. This raised the minimum frequency from 600 to over 800 MHz with 2 volts on the VT line. The upper frequency limit was increased to about 1200 MHz at 12 volts on the VT line. This allows 1060 MHz to be obtained with a VT voltage of about +10 volts instead of +20 volts.

If a lower VT control voltage is needed in your application, lift one end of the varactor in the VCO and place a 5 pF cap in series with the diode. This reduces the higher capacitance of the varactor at lower VT voltages and allows 1060 MHz to be obtained at about 4 volts on the VT. In this case about 3 to 5 volts is required on the VT line and is suitable for PLL control applications. Additionally, the entire converter can be operated from a 12 volt power source. If you want to use the simpler manual control only, place the wire across the oscillator inductor and omit the varactor changes. See Figure 5 for oscillator modification details for +12 volt modifications.

The third option is to convert the input bandpass filter of the CATV tuner

(varactor tuned from about 50 to 400 MHz) and connect it to the output of the mixer for a tuned output filter. This filter can be used to remove any unwanted products in the output IF path to the TV receiver as it covers the required tuning range of our new IF, from 174 to 216 MHz (that is, TV channels 7 to 13), that we use as our receiver IF.

If You Don't Have an SRA-11 Mixer

Not to worry, the mixer that is part of the tuner is a good mixer, but for our application requires some surgery to make it functional for our application. In the original CATV application conversion loss (about 25 dB) was not a priority due to the high-level signals being received. To amateurs this is undesirable; we need all the gain (or least loss) we can obtain. A simple modification will render the onboard mixer usable for our application, yielding a conversion loss on the mixer of about 10 dB.

To achieve this lower loss we need to remove the input ferrite transformer (T1) entirely. Just cut it off the PC board with an X-Acto knife. Leave the ferrite transformer (T2) that is center-tapped with a capacitor going through a feed-through in the case wall. This is the local oscillator input to the mixer. On the rear of the mixer PC board, the input coil that remains (T2) needs to have one side grounded. The other side connects to the IF input. These leads previously went to toroid T1 which is now removed; add two jumpers: ground on the right and the jumper to the IF input on the left. A 0.001 to 0.1 µF capacitor needs to be added to one side of the mixer to complete the modification. The capacitor connects to the output of T1 at the coupling capacitor to ground. The capacitor value is not critical; 0.001 to 0.1 µF will work well. See Figure 4 for exact placement. This spot is marked by an asterisk. This simple mixer modification improves the mixer conversion loss to about 10 dB at 1200 MHz.

Well, there you have it: the first cut at a 1240 MHz ATV converter. Of course, there are other possibilities as well for the CATV tuner. An ATV converter could be constructed for 450 MHz as well. To put these ideas into reality all I have to do is to set up some more antennas to allow all this testing. What I really need (as long as I am putting together a shopping list) is a small stepstairs to the roof to provide access to an elevated test platform. On this platform there would be AC power and devices for antenna testing of projects such as this. Oh well, dream on.

As with any modification of circuitry there will always be questions on where exactly to make the connections. Don't be intimidated—dive in and give it a try. Go slowly and think each step through before cutting circuitry. Treat each circuit element as just that, not as a complete unit in one whole diagram. If you refer to the block diagram and photos provided in this article you shouldn't have any trouble.

To gain access to the internal components I used a pair of long-nosed pliers and straightened each of the metal "ears" that hold the cover plates on. When all ears are straight, the covers should pop off easily without undue pressure. Follow the circuitry and look for obvious connections between compartments as only the DC and signal paths make connections between compartments. All other circuitry is contained within a compartment.

In Figure 1 where I placed labels (RF, IF, LO) by the mixers, these are the approximate PC board locations where the interconnections are actually made for these circuit elements.

DC	Freq.
0	566
1	582
2	601
3	630
4	658
5	685
6	711
7	738
8	763
9	788
10	812
11	844
12	866
13	898
14	926
15	954
16	979
17	1000
18	1023
19	1040
20	1061

Table 1. Frequency of VCO before modification. With Mod #1 (Figure 5) circuit will tune about 800 to 1200 MHz from +2 volts to +12 volts.

Well, that's it for this month. Next month I plan to complete the synthesizer and dive into a simply-constructed 1200 MHz antenna. I would like to develop a sweep driver to use the tuner as a spectrum analyzer, but for now that part will have to be put on hold. First, the ATV projects; then let's see what happens. By the way: The synthesizer we constructed uses a Motorola synthesizer chip, the MC-145106.

I will make the CATV tuners available. For those who wish to purchase a CATV tuner with a Qualcomm amplifier cost is $25 postpaid. The CATV tuner or Qualcomm amps are available for $15 each; for additional tuners or Qualcomm amplifiers add $10 each. Units are surplus/brand-new. Prices are U.S./Canada postpaid.

As always, I will be glad to answer questions concerning this and other aspects of our upper frequencies. Please send an SASE for a prompt reply. 73, Chuck WB6IGP

Std. TV Channel	Frequency (MHz)
2	54-60
3	60-66
4	66-72
5	76-82
6	82-88
7	174-180
8	180-186
9	186-192
10	192-198
11	200-204
12	204-210
13	210-216

Table 2. TV frequency.

Number 19 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Phase-Locked Loops

A long time ago, I did a column on phase-locked loops (PLLs) and their use in frequency synthesizers. This time, I'd like to look at PLLs with regard to their many other uses.

What Is It?

Just what is a PLL and why is it so useful? Basically, a phase-locked loop is an oscillator which can be made to track, or lock to, an incoming signal. You might wonder just what the point of that is. After all, if you already have an incoming signal at the frequency you want, why bother to create another one just like it?

The beauty of the PLL is that, while its output normally does track its input's frequency, it can have various other characteristics, some of which can be important and useful. For instance, the output signal can be of a different shape than the input. It could, perhaps, be a lot cleaner, or it could be a sine wave when the input is a square wave. In fact, that's a common use for a PLL: creating a sine wave from a pulsed, digitally controlled source. Another great use for the PLL is when you want to recreate a badly degraded signal, as is done in a shortwave radio's synchronous detector. A PLL sync detector phase-locks to the incoming AM carrier. Then, when the signal fades in and out, the loop stays locked and continues to supply the radio with a constant, clean carrier, which really helps reduce fading distortion in the demodulated audio. In fact, a well-designed loop can stay on frequency even if the carrier completely disappears for a second or so, which really helps with deep fades.

The output signal of a PLL also can be made at a multiple or submultiple of the input. In other words, the loop can be used as a frequency multiplier or divider, and it will track the incoming frequency while it performs its division or multiplication chore. For division, that might seem overkill. After all, darned near any old digital gate can be made to do division. Yes, but only if you want square waves! For multiplication, though, the PLL represents one of the easiest ways to do the job. If you want, say, a frequency at three times the input, which tracks some modulation in that input, how else are you going to do it? Sometimes a simple harmonic tripler would work, but the frequency range of such a circuit could be too narrow. With a PLL, you can do it from audio on up to RF.

Finally, a PLL's output doesn't have to be from its oscillator! What else is there? A particularly useful output is the control voltage which is used to make the oscillator track. Using that voltage as an output, it is easy to make FM and FSK demodulators.

How?

To understand the operation of all these circuits, it's necessary to grasp the basic operation of a PLL. This circuit scares a lot of people, and it really shouldn't. I don't know where the mystique about PLLs came from, but they're really not that complicated. Let's examine the basic operation of a PLL.

A phase-locked loop consists of three basic parts: an oscillator, a phase detector and a feedback network. The oscillator is not much different from any oscillator you already know, except that it's a VCO, or voltage-controlled oscillator. That lets the rest of the PLL adjust the frequency by varying a DC voltage. And, just as gross adjustment can change the frequency, fine variations in the DC control voltage can adjust the oscillator's phase. After all, the only difference between frequency and phase change is amount. In fact, that's where the phase-locked loop gets its name; it can lock its oscillator's phase to another signal, and it controls it with a feedback loop configuration, in which it monitors its own phase and corrects it until it matches.

"A phase-locked loop consists of three basic parts: an oscillator, a phase detector and a feedback network."

The phase detector is at the heart of the loop. This thing has two inputs; one for the incoming signal and another for the PLL's oscillator. The output of the phase detector is a voltage which rises and falls according to which input leads or lags the other in phase. When the two are not even on the same frequency, the output of the phase detector goes up and down at a rate which equals the difference frequency between the two signals. It does that because the two are periodically crossing each other in and out of phase. I suppose that's the difference between a phase detector and a frequency detector; the phase detector has no way to tell which input is higher or lower than the other's frequency.

A Weird Idea

I suppose that, if you disconnected the oscillator's DC control line and fed it with a fixed voltage, you could use a PLL as a kind of IF subsystem for an FM receiver, as it would have both an oscillator and an odd kind of mixer (the phase detector), which would produce a difference frequency which could then be demodulated, perhaps with another PLL! It would only work for FM, though, because you'd lose the AM envelope in the phase detector. I've never seen it done, most likely because commonly available PLLs won't operate at high enough frequencies to be very useful as radios. Besides, real FM subsystem chips are already cheap and common. Still, it would be an interesting thing with which to experiment, perhaps in a project which had some characteristic that made the use of standard FM chips unfeasible.

Back To Our Show

Sorry for that digression, but the idea just seemed too cute to ignore. Anyway, back in our conventional PLL circuit, we have our phase detector connected to the feedback network, also known as the loop filter. Usually, this is no more than a resistor and capacitor, although it could contain some coils or, in the case of a frequency multiplier, some active circuits. The purpose of the feedback network is to control the oscillator in a specific way. Let's say we want the PLL to track the input as fast as possible. If we just connect the output of the phase detector directly to the oscillator's control input, what happens? Well, it's safe to assume that, at first, the incoming signal and the VCO will not be on exactly the same frequency. So, the phase detector's output will swing back and forth as the two periodically cross in phase. That'll swing the oscillator back and forth, causing the phase detector's periodic swing to change its rate, because the oscillator feeds one of its inputs. The whole thing will continue to bounce up and down, out of control, and the VCO will *never* get locked to the input signal. That's not very useful. But what if we slow the action down a bit? Specifically, what if we make our feedback network significantly slower than the rate of change of the signals themselves? Let's say we have a 1-MHz signal rate, and we make the loop filter react no faster than 1/10 of that rate. What happens then? Now, the initial swings in the phase detector's output will be integrated into a rising DC voltage, which will gradually pull the oscillator up (or down, depending on the design). When its frequency gets to be the same as the incoming signal's, the phase changes will stop, and the detector's DC level will freeze at a specific level. If, as is likely, the VCO's phase does not match the incoming signal's, the DC will adjust slightly up or down until the oscillator exactly matches the signal. The whole process can still be very fast, and loop instability can be completely prevented. And that is how a real PLL works!

Getting Loopy

Often, a simple RC loop filter is all you need for your feedback network. There are ways, though, to make filters which have special characteristics. For instance, you may want your PLL to lock up very fast but then tolerate some wobbling in the input frequency without pulling on the oscillator. And that leads us to another powerful use for the PLL: as an FM detector.

Up to now, we've been considering the PLL's oscillator output as the reason for using it. What if, though, we pick our output off another part of the loop? What about the VCO's control voltage? What does it represent?

In the previous circuit, all it represents is the PLL's internal housekeeping. You can, however, make it represent *information*. Let's say we feed the PLL an incoming signal which contains FM information. In other words, the signal deliberately wobbles around in frequency a little bit. Now, when we feed it to our PLL, we set the loop's VCO frequency to nominally rest at about the frequency the incoming signal would have with no modulation. As the signal wobbles around, what happens? The loop attempts to track it, right? In doing that, it moves the control voltage around each time the signal wobbles. As its frequency goes up and down, so does the control voltage. Does that sound familiar? Yes—the control voltage is tracking the frequency changes in the incoming signal, so it represents the same modulation signal it originally *took* to wobble the signal around. Thus, the control voltage has demodulated the FM information, and can be directly used as an output! And, the time constant of the loop filter sets the loop's upper frequency response. If we set it to be just a little bit faster than audio, we can feed in the output of an FM IF stage and out will come audio! If we want to limit the response to, say, 5 kHz, we just slow the loop down with a bigger loop filter, and it will be unable to respond faster than 5 kHz. Thus, the varying control voltage will never move faster than that. Pretty slick, huh?

Going Up?

One of the most fascinating uses for the phase-locked loop is as a frequency multiplier. Frequency multiplication is inherently different from frequency division. In division, all you're really doing is making the circuit change state on every certain number of changes in the original frequency. So, if you want to divide by three, you just count every third cycle and you're done. But in multiplication, you need *more* changes than you start out with. To multiply by three, you need three

changes for every one in the original signal. That doesn't sound so hard, but how do you make them all evenly spaced so that the output is a continuous signal? How do you make something change state when there's nothing to tell it when?

Divide and Multiply

Using a PLL for this task lets you pull a clever trick. Let's say you take the PLL oscillator's output and run it through a frequency *divider* before you send it to the phase detector. What happens then? If we divide the oscillator by three, then the phase detector thinks that VCO is running at one third the speed it really is. Let's make up an example to see how it works:

Fooled Ya

Let's say our incoming signal is at 1 MHz, and we want our output at 3 MHz, phase-locked to the input. If we divide the VCO by three, using a couple of digital gates or flip-flops, the loop will think both the input and the VCO are running at 1 MHz, and will phase-lock the VCO to the input. But, in order for the divided VCO to be at 1 MHz, the *true* VCO frequency has to be 3 MHz, thanks to the divider, so, when the phase director looks up the loop, the VCO will be phase-locked at the same multiple of the input frequency as the divider is set to. If you divide by three, you wind up multiplying by three. And, as the input signal changes in frequency, the multiplied signal will follow it, as long as the input's changes are not so far off that the loop can't stay locked.

Everything Has Limits

That brings us to the last important point about PLLs. All of the design parameters are adjustable, and some of them fight each other. One important one is the frequency range the input signal can have while still keeping the loop locked. If it goes far enough off, the loop will unlock, making its outputs meaningless. Normally, PLLs have a "locked" signal which changes state when lockup occurs, so you know when you're in range. Still, the lockup range can be deliberately set, and sometimes you really want it narrow, to avoid having the loop lock to unwanted signals near the desired frequency. Other times, you want as wide a range as you can get, to allow a signal to wander all over the place and still keep the loop locked.

Try It!

Well, I hope you've enjoyed this little journey through the innards of the phase-locked loop. Why not play with one? Get yourself an LM565 or a 4046, read the data sheets, and see if you can make those chips play. I'll bet you can! Until next time, 73 de KB1UM.

Number 20 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors, Inc.
P.O. Box 131646
Staten Island NY 10313-0006

A Shocking Experience

There are certain experiments and science demonstrations that simply lend themselves to fun in the classroom. One of my personal favorites to do with youngsters is the one that demonstrates some of the principles of electricity via static electricity experiments.

Depending on the age level of the group you teach, you can have a brainstorming session to introduce or reinforce the meaning of "shock." Almost every child will have a "shocking" example or story to tell. We discuss the different kinds of shocks there are, and how in the wintertime we can do some really "shocking" things in our classroom.

We review that electricity is caused by movement of electrons from one atom to another. Static electricity, however, unlike the current that flows through the outlets at home, is at rest. The electrons (negative charges) in static electricity are passed from one object to another and stop there. The object that has gained electrons is negatively charged and the one that has lost electrons is positively charged.

Except for having fun with dramatic demonstrations in front of people, static electricity is most often just a nuisance. Point out to your audience how unruly our hair can get when we brush it on a dry, winter day. When walking briskly across the carpet we can get shocks; and sometimes static electricity causes our clothes to cling. This is all harmless enough; but on a larger scale, lightning is caused by static charges that develop in the clouds. The energy released by a lightning bolt is thousands of times stronger than any other the children are likely to encounter.

Class Experiments

The classes always enjoy the experiments we do with static electricity. Here are some that can help kids learn more about the properties of things around us.

Thousands of years ago in ancient Greece, a scientist named Thales observed an unusual property of amber, a plastic-type material commonly used for jewelry. When rubbed briskly with fur, pieces of amber (or "elektron," as it was called) would attract small bits of cork, wood, or similar objects in much the same way that a magnet attracts iron-based metallic objects. Thales didn't understand why this occurred and assumed there was an unknown force in the amber. This force, of course, became known as electricity.

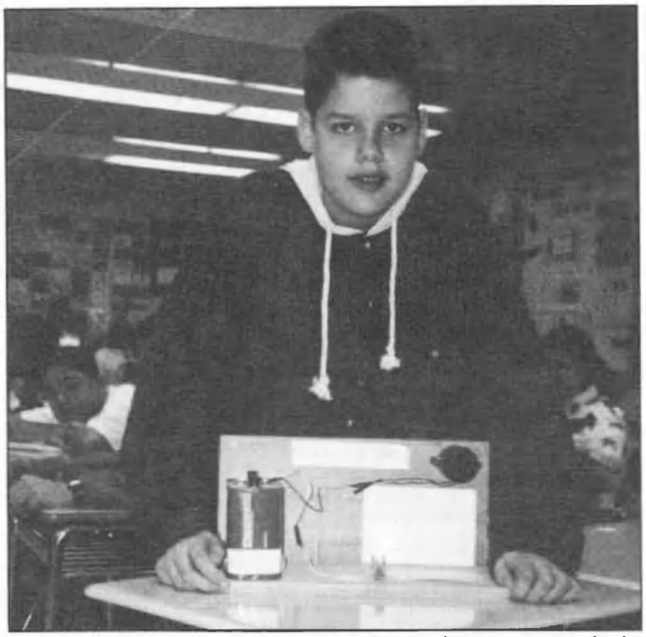


Photo B. Seventh-grader Juan Lugo demonstrates a follow-up project of a fire alarm he made.

"Except for having fun with dramatic demonstrations in front of people, static electricity is most often just a nuisance."

With this as a background, have the children bring in a large plastic comb (instead of the amber), and a warm, dry flannel cloth (instead of the fur). This demonstration works best on a dry day. Hold the comb in one hand and the cloth in the other. Briskly rub the comb a dozen or more times. Now bring the comb near some small bits of cork or paper and watch the pieces "jump" to the comb.

Here are some more static electricity experiments from *Planet Earth* by Clay Wollney. The supplies you will need are: two or more balloons, a coat hanger, three feet of string, a piece of wool clothing, and a spray bottle filled with water

1. One of the easiest ways to demonstrate static electricity is to blow up a balloon and rub it vigorously against your hair. Touch the balloon to a wall. Electrons picked up by the balloon as you rubbed it on your hair caused the balloon to become negatively charged. It is attracted to the wall since the wall is not negatively charged.

2. Blow up a second balloon to the same size as the first. Place the string over the hanger and tie a balloon to each end of the string. Hang the hanger so that the balloons dangle alongside one another. Now rub one balloon with the wool and then release it. Is the other balloon attracted or repelled? Now, rub both balloons with the wool and release them. Do they still behave the same way? When only one was charged the balloons clung together (unlike charges attract). When both are charged, they push each other away (like charges repel).

3. Static electricity is more of a problem on dry days than on rainy ones. Water acts as a conductor, allowing charges to flow easily from one object to another, so charges don't build up. Charge both balloons, then spray the finest mist possible between the balloons. Does the moisture in the air change their behavior?

Be sure to take pictures of the children's faces while they do these experiments. Send me your best photos so we can share our experiences with other instructors.

Photo A. Many museums, like the Franklin Institute in Philadelphia, have hands-on displays demonstrating static electricity.

NEVER SAY DIE

Continued from page 4

Hamming Irrelevant?

Will the development of the "information superhighway" eventually make amateur radio irrelevant? The internet is already offering far better communications facility than amateur radio. Our ham contacts with other countries are severely limited by (a) propagation conditions, (b) interference (QRM), (c) noise (QRN), (d) fading (QSB), (e) language differences, and (f) time differences.

We could overcome some of these limitations if we developed a worldwide satellite repeater communications system. This could help us avoid our problems with ionospheric propagation, noise, and fading. We might even be able to develop systems which would reduce interference. And the time isn't far off when we could even overcome language differences with software. But I have to admit that despite my endless nagging and urging that such a system be developed, I see little sign of any amateur interest in the project.

That being the case, the Internet approach will win by default. E-mail does about the same thing as packet radio, only without all the miseries we're fighting with shortwave packet circuits. Worse, while amateur slow-scan is creeping along, the growth of MPEG and other systems of reducing video bandwidth will be making not just good quality photos available over the Internet, but full motion, high quality video.

Right now you can get on the Internet and strike up a live conversation with people anywhere in the world. It is already providing the service we only wish we could. It's better, in that once you get familiar with the Internet you can find like-minded people to talk with on virtually any subject. One time, many years ago, I proposed the development of such a system for amateurs. I'd love to find hams interested in the things I want to learn about and talk with them. I'm getting less and less interested in taking potluck, and finding it difficult to discover any area of mutual interest from among the largely retired hams inhabiting 20m these days.

I'd love to talk about cold fusion, sky diving, scuba diving, cooking, and any of a hundred or so things I'm interested in. One time on a ski lift in Aspen I met one of the leading astronomers and we had a momentary talk about the bubbly nature of the universe, which he'd recently helped discover. Another time I went up the lift with Mike Markkula, the chap almost singularly responsible for Apple's growth in the early days. Mike is not a ham. Nor was the astronomer.

Sure, I might luck into contacting King Hussein, but even if I did, after about 10 microseconds the frequency would be totally wiped out by DXers frantically calling him to get a QSL card. I remember trying to get through to Arthur Godfrey one time when he was on a DXpedition to the Sahara. He had Colonel Carroll Cone with him, an aviator friend of my father's I'd known from childhood. He and my father were in the Army together when they learned to fly in San Antonio in 1921. I desperately wanted to get through and say hello. No way. I still remember that frustration.

Many of the cold fusion scientists are on the Internet, where I can communicate live or via E-mail. The rest of them will soon be on. I'll be there too, looking for interesting news about kit planes, ultralights, hang gliding, places to go diving, new countries to visit, and a whole bunch of new ways to generate power. Then there's my growing interest in finding out more about life. I've been cluing you in as I've discovered exciting books about this. I know there are probably hundreds more books I'd love to read, if only I had some way of finding them. This is what the Internet will eventually offer. Yes, it's something amateur radio could offer, but only if we had the pioneers to make it happen. Alas, we seem to have killed off the interest that attracted youngsters to the hobby, and without young blood, we've run out of steam in the pioneering department. How many famous explorers started when they were at retirement age? And that's what our average ham is approaching.

I wonder if there will ever develop on the Internet anything like our ham contests? Well, they already provide contest areas for chess, and probably some other games. How long will it be before an Internet computer shuffles and deals the card for bridge, canasta, and even poker? I've spent weekends doing the Sweepstakes contest, DX contests, and VHF contests. They were fun and exciting. I'm glad I did them, but there's no way I'd get involved with doing them again. I no longer have the time to invest in that kind of entertainment.

Is the collection of QSL cards any better than collecting matchbooks, stamps, or even sugar packets from restaurants around the world? I've got boxes of QSLs, stamps, matchbooks, and sugar. They're only a problem for my heirs. Heh, heh. Imagine being faced with six big boxes of sugar packages from maybe a hundred countries. Can you throw them all out? Who would want them? Are they worth anything? I guarantee that old QSLs have zero value, so they'll hit the trash can soon after you win your Silent Key award from the League. Hey, you don't even have to be a member to win that one. Of course, you can only win it once.

How many of you are checking into a ham group on CompuServe? Prodigy? America Online? The Internet? As soon as we reach the 50% level we can start petitioning the FCC to auction off our bands and agree to split the proceeds with them. If only the chaps actually using the bands pocketed the money, they'd all be able to retire immediately.

The FCC, which already has the taste of blood from their recent frequency auction, may already be sniffing at the 99.8% of our ham frequency allocations that we're not using. And, unless something major happens, will never use.

What could change all this? Only a miracle, and it's been a couple of millennia since the last big miracles. First, the ARRL directors would have to change their minds about the code, and you know how likely that is. Without the code obstacle we might stand a chance of attracting youngsters into the hobby. That, alone, won't do it. The League directors would also have to change their minds about keeping out newcomers. They seem to feel that we have more hams than we need . . . just listen to the QRM on 20m, if you think otherwise.

If we were to change things. If we were to think in terms of marketing the hobby, of making it attractive to youngsters, of advertising and promoting it, we might be able to bring in enough newcomers to hold our bands. And none of this 20 wpm stuff for the Extra Class license. We need a couple million young hams, and we're not going to get them while we're using the code as a barrier. But I've written about all that before. You didn't agree then and you probably don't agree now, or you'd have done something. That's OK, I'll keep publishing my magazines as long as amateur radio (or I) survive. Right now I think the odds favor my surviving a lot longer than amateur radio, and I've got a long list of ailments. Ask me about that sometime on the air.

No, I'm not going to petition the FCC for the changes I propose. I'm not your leader, I'm just the coach. Ham radio is still mostly a hobby for me and I intend to keep it that way. Oh, I thought about the leader business years ago, but that takes building something like the ARRL, complete with all the nitty-gritty of dealing with government agencies, militant gays demanding the "right" to advertise for members of their gay club, militant femmes demanding an end to the use of "YL" in the club publications, militant crippled hams demanding a column for the physically challenged, and so on. I'm trying to think of something I can militantly demand as a right.

Meanwhile, thousands of people are signing onto the computer networks every week, and the more youngsters that go that route, the less need there will be for amateur radio. Unless you can come up with some benefit that amateur radio can provide that the nets can't. Please advise.

One more thing. I don't want to get any messages from you that you don't always agree with me. If you disagree on the above, you damned well let me know why. That means you've got to do some thinking. For some of you, it's about time.

Better Junior Ops

My search for a way to generate more young hams has taken a strange turn. My original goals were to (a) provide a solid excuse for our hobby to be kept alive, despite the pressures for our valuable spectrum by rapidly expanding commercial interests and (b) help provide the high-tech work force our country is going to need to compete against the other industrial countries in the next century.

If we're going to do this we have to get kids interested in hamming. This brought me head-to-head with the mess our schools are in. And that, in turn, got me to reading about our educational system. I've found that I'm not alone in criticizing our school system.

Now, before I get really started on how lousy our schools are, let's just consider what you might do if you were interested in having the very best child or grandchild you could. First, let's talk about what can go wrong, and then we can discuss how to fix the situation. I'm presuming, of course, that you might have an interest in giving your children the best start in life that you can. Maybe you don't care.

By the time your kids are seven the largest part of their characters will have already been formed. The child at seven won't be very different fundamentally from the teenager at 15, or the grown-up at 30.

Your child starts with the sperm and the ova. Anything you do to screw up your DNA before conception is going to affect your kid, and not positively. If you mess your sperm up enough, there'll be a miscarriage. But a lesser change in the DNA message will just burden your child with problems. There may be health, behavioral, or even cosmetic problems.

So what can we do to give our kids the best possible start? Well, research has shown that there are a lot of things that affect our sperm. There are drugs such as nicotine and alcohol. There are magnetic fields such as we find with electric blankets or living near power lines or power sub-stations. There are poisons such as mercury, silver, and nickel, which we can get from amalgam fillings in our teeth. Most of us already know about crack babies, and problems from cocaine, pot, and the hard stuff.

So let's say that you and your wife go out of your way to give your kid the best start you can. Then comes birth. I've got to get you to read *The Continuum Concept* by Liedloff. That'll keep you from letting the hospital put your baby in their nursery. This is a wonderful guide book for the first year of life.

Next comes the pre-school era from one to five. This can be a time of incredibly rapid learning. It's a wonderful time to teach babies several languages, if you have a way to continue and develop their use later on.

Unfortunately, even if we've done everything the best we can until we send them to school, this is when we will permanently screw up their lives. I

hope I can get you to get the book by John Gatto, the New York State Teacher Of The Year, *Dumbing Us Down, The Hidden Curriculum of Compulsory Schooling.* It's inexpensive and a humdinger. Of course, since you are an alumni of this school system, the chances are great that you do not have any interest in reading books. Do you know that the average American school teacher only reads one book a year? And then, even if you do read Gatto's book and get all upset when you find out what's been going on in schools, you have been so conditioned by your own school experience that you are gutless and won't have the initiative to even try and do anything about it.

Heck, I've discussed the major problems facing our society and proposed inexpensive, creative solutions to them in my *Declare War* book. Several thousand people have bought it, yet I've seen no movement to try to implement any of the proposals. "It can't be done. It's hopeless." Until I read Gatto's book I hadn't realized why I was getting verbal and written support, but not seeing any sign of people doing anything.

I was around 11 when it finally dawned on me that kids had no more rights than slaves. By law I had to go to school. The only rights I had in school were those the authorities let me have, and they have been backed up by the Supreme Court in this. I was forced to comply by the use of embarrassment and humiliation. You do nothing unless the teacher tells you to . . . which stifles thinking and makes you dependent on the teacher. I see this pattern in many of the youngsters I've hired, who are unable to think for themselves. They sit and wait until they're told what to do. They are unable to plan work. They've always been stopped before finishing something by the bell, so they're not familiar with the concept of completing work.

Gatto says, "It is the great triumph of compulsory government monopoly mass-schooling that among even the best of my fellow teachers, and among even the best of my students' parents, only a small number can imagine a different way to do things. Only a few lifetimes ago things were very different in the United States. Originality and variety were common currency; our freedom from regimentation made us the miracle of the world; social-class boundaries were relatively easy to cross; our citizenry was marvelously confident, inventive, and able to do much for themselves independently, and to think for themselves."

Gatto points out that it only takes about 100 hours for a person to learn to read, write and do arithmetic, as long as they're willing to learn. From then on they can teach themselves. "Schooling, through its hidden curriculum, prevents effective personality development. Indeed, without exploiting the fearfulness, selfishness, and inexperience of children, our schools could not survive at all, nor could I as a certified teacher. Nobody survives the curriculum completely unscathed, not even the instructors. The method is deeply and profoundly anti-educational. No tinkering will fix it . . . don't be fooled into thinking that good curriculum or good equipment or good teachers are critical determinants of your son's or daughter's education."

He points out that before television children had enough time to themselves to learn about self-motivation, perserverance, self-reliance, courage, dignity, and love. Now kids, on the average, spend 55 hours a week in front of the TV. That's one-third of their time. Add to that the stresses of a two-income or single-parent family, and our kids have too little time to learn to become human.

Is it any wonder that our engineering universities are running out of potential students, and are having to continuously lower their admission standards? Only 7% of the high school graduates in America have enough math and science background to be accepted by an engineering college. The colleges have responded by turning to foreign students. That's great for other countries, but it sure leaves ours in a fix. Here we are heading into a high-tech future and we're turning out fewer and fewer engineers, technicians and scientists.

The time was, 50 years ago, that youngsters wanted to be hams so badly that they'd put up with learning the code as a barrier. I did, even though I hated being forced to do something which did not make sense to me even then. Very few of the kids these days have the passion to surmount obstacles, so we've instituted the no-code license. Well, we've been lowering the standards for school grades in order to get our kids through school, which is the same thing. They're even lowering the SATs because our kids' scores have dropped so much. Now I see some hams pleading that we lower the technical exam standards so kids won't have to memorize so much to get a ticket.

There may be some American schools that are pretty good. I've read about a few. But most of the better-educated children today are being schooled at home by their parents. Maybe you've read about it in *Newsweek.*

Home schooling will be a lot simpler once we have a good video educational series parents can use. These would use top-notch performers, plenty of graphics, and be fun to watch. PBS has been producing some superb educational videos. Now we need to have them to cover everything being taught in the K-12 years, plus everything that should be being taught. And also plus everything kids might want to learn, but which isn't being taught. We need thousands of these videos.

We'll still need schools to provide the hardware and facilities to teach skills. You can teach a lot about driving with a simulator, but then you need a car. Ditto flight simulators, etc. You can't learn to juggle with a simulator, or to throw a boomerang. Or do glass blowing.

College? There may be some that are okay, but if you read the books on education you'll find that most aren't much good. Most of the "teaching" is done by student instructors. Get a copy of Thomas Sowell's *Inside American Education,* 1993, Free Press, $25.

If you learn much about nutrition you won't let your kids near a McDonalds. Granted, it's difficult to get the facts on nutrition. The field is overgrown with fads and scams. But if you want to raise healthy, happy, intelligent children, you'd better learn.

So much for today's sermon. If you're interested in learning more about education, I've got a bibliography available of the more important books I've found on the subject. Send me an SASE and then head for a good library.

Oops!

Did you or did you not send for the ham CD composed and sung by Andrew OZ1XJ and Lissa OZ1XY which I wrote about in the December issue? What do I have to do to get you to support ham entrepreneurs? Particularly ones with outstanding products? Sigh . . . sometimes you almost discourage me. The songs on XJ and XY's CD are by far the best ham-oriented songs I've ever heard . . . and "ever" is a long time for someone who's been hamming for 56 years. One picky-picky reader noticed that I got Andrew's call wrong in my write-up. It's OZ1XJ.

No, please don't tell me that you don't have a CD player. Compact discs have been out for over 10 years now and LPs have almost disappeared, which tells me that you are either making do with the garbage music you get from radio, or that you are missing one of life's great pleasures. No, I don't expect you to go berserk buying music, but good grief, you certainly should have a decent CD collection by now. It's like not reading books and magazines. It shows a poverty of intellect and imagination.

You need to spend some time quietly thinking, some reading, both for enjoyment and furthering your education, and some time listening to music. It wouldn't hurt for you to spend some time writing too. Far too many hams that I talk with on the air seem to be one-dimensional (or less). Now and then I run across someone I can talk music with. What pieces by Gottschalk or Nazareth are you familiar with? Lamb, Ippolitov-Ivanov, Gliere? Songs from the 1890s, show music of the 1930s and 1940s? Sousa, Strauss? If you hear me on the air let me know what music you've heard recently that you think I may have missed. Or what books you think I might particularly enjoy.

How'd You Do?

Yes, I tried to make my little 33-country DX contest in December (p.76) a nasty one. I have to uphold my reputation, right? Plus I got to brag, since those are all countries I've visited. I should have started writing my travelogues years ago. Of course my main reason for bringing all this up is to put a burr under your blanket and get you off dead center. It's great fun to visit and get on the air from rare countries, and it doesn't have to cost a fortune. You're a ham, so how about doing some real hamming?

If you don't want to be bothered with the weight of a rig and the customs hassles, make a deal to use the station of someone in the country, with the promise to take care of the OSLs. Most hams in rare countries really hate being forced to make 30-second contacts by the gross just to have to fill out a QSL card. A few are taking advantage by asking for green stamps, and making a nice profit on the deal. I remember one famous DX-peditioner I knew very well who charged $50 each for QSLs from the rare countries he put on the air and bragged that he was pulling down over $50,000 a year tax free with this scam. He got so greedy that he made thousands of contacts from countries he didn't even visit.

I've never had any problem finding a station I could use during my visit to most countries, so I've rarely had to take a station along on my trips . . . except for a 2m HT.

Religion and Politics

We sure seem to have a problem in America with religious zealots trying to force the government to pass laws supporting their religious beliefs. We had prayers every day in schools for years without it hurting anyone . . . then someone decided to make a big deal out of it and look at the mess we have with the school prayer pro and con groups. Then there's the creationist baloney, where a few religious fundamentalists want to force our schools to teach their religion. And look at the awful mess we have with the pro and con on abortions!

The "Right To Life" bumper-sticker crowd are basing their rhetoric and beliefs on the lie that life begins at conception. That's a crock. Both the ova and the sperm are demonstrably quite alive well before they ever get together. Indeed, we have a ton of published research reports showing that a man's sperm can be damaged by smoking, drinking, or taking drugs before conception . . . and that this damage results in often serious problems for the resulting child. Ditto the mother's eggs, which can also be damaged by pre-conception drugs in her system.

Will the right-to-lifers start trying to get laws passed making it illegal to kill sperm? The Catholic Church already is on record as opposing the frivolous waste of sperm, right? But what about the 499,999,999 sperm that don't make it at the moment of conception? They're all alive and every one of them has the potential to start a child. Will we start seeing movements to

make sure that none of a woman's eggs are allowed to die? Will they picket the Kotex Company, which is abetting this terrible loss of life? Millions of potential American babies are being killed every day! Let's put a stop to this awful human carnage.

OK, maybe we shouldn't consider life starting at conception. So when does it start? You're not going to like this, but my earlier concept of life being alive and well before conception is, in my professional experience as a psychotherapist, quite accurate.

The psychotherapy I used involved using hypnotism to regress people to the moment when a current day psychological problem or illness was triggered by a past traumatic incident. While most problems resulted from incidents after birth, not a few involved things that happened during pregnancy, and every now and then some patients would go back even before conception with recollections of traumas. I'm not talking about past lives incidents, but those which involved the sperm or the ova before conception. If you know a good hypnotist you, too, can go back to that period of your life and rerun it. It's there and it's recorded in some way we still don't understand. You can even fast-forward it, if you want.

The death of someone we love is a tragedy. The death of a wanted baby is a tragedy. But I remember all too well one woman who's mother cursed her every day of her life because the mother got pregnant and "had to" marry the father, who was an unmitigated louse. The daughter, who was beautiful, grew up totally believing that she was ugly and worthless. She was a real mess mentally. Manic depressive. She, in turn, passed along this heritage to her daughter.

Subtle Energies?

One of the more interesting conferences I've attended was a subtle energies conference in Monterey (CA) put on by the International Society for the Study of Subtle Energies and Energy Medicine in 1993. I missed their 1994 conference because I was all tied up with the mess I told you about, when a couple of employees, with the help of a certain pinko opportunist most of you know, tried to put me out of business. I won't miss their 1995 conference.

OK, what are "subtle energies?" No one knows. Yet. Indeed, they may not be energies, though they act like them. The main thing I appreciated with this group was their open-mindedness. Let me quote from one of the presenters, Larry Dossey, M.D., "And anyone who at the present day expresses confident opinions, whether positive or negative, on ostensibly paranormal phenomena, without making himself thoroughly acquainted with the main methods and results of this careful and long-continued work, may be dismissed without further ceremony as a conceited ignoramus.

"The failure to understand how something happens in science, however, is not a particularly damaging admission. At the turn of the century, scientists were unable to explain a very common event: sunshine. An explanation of how the sun shines had to await the development of nuclear physics. In the meantime, the lack of an explanation hardly annulled the fact that the sun did indeed shine."

The lack of radio signals from other civilizations may have more to do with our primitive communications system. There could well be some sort of life-force communications system which is instantaneous and not limited by distance. Once that is discovered we may suddenly find ourselves in communications with an infinity of other beings. Once a civilization progresses to using thought for communications, why would they need slow, bandwidth-bound, interference-prone, radio? That might explain the lack of radio signals from space.

We have a host of hints that there may be some new kind of communications medium that we haven't identified yet. At the last conference I was fascinated by a video showing a psychic influencing the surface tension of water on cue from hundreds of miles away. She also was able to disturb a cloud chamber on cue.

I hope some of you who are interested in learning more and have the time to attend the conference will be there with me this year June 23-26th in Boulder (CO). You can get more information from ISSSEEM, 356 Goldco Circle, Golden CO 80403; 303-278-2228; 279-3539 Fax; CompuServe 74040,1273.

IBM and Apple Both Fail? That's Ridiculous!

There's still time for either or both companies to be rescued, but I'll be very surprised if it happens. Are you interested in what's gone wrong and why I think the problem probably is terminal? Well, I'll tell you anyway.

Both companies have had recent CEO changes as a result of poor performance. But the new CEOs, unfortunately, aren't the right people for the emergency. With both companies having financial problems, their boards have reacted reflexively and put in bean counters. Financial men to handle financial problems, right? Bad decision. If I'd been on either board it never wouldn't have happened that way.

But then I haven't seen any sign that the boards of either corporation have anyone who really understands the business they're in and the sweep of history in this industry. I guess you had to have been there to know what's been going on inside the industry.

Let's Take Apple First

Steve Jobs has been hailed as a visionary because of the popularity of the Apple. Ditto John Scully after him. I think I can make a good case for neither really being visionaries. Indeed, Scully was brought in to rescue Apple from Jobs' monumental blunders, which were sinking the company. We've had a good practical example of Jobs' vision in the dismal failure of his NeXT computer, which is now kaput except for its operating system.

The original Apple was put together by Steve Wozniak. Jobs, his friend, had been selling those illegal blue boxes to people wanting to cheat the phone company out of long-distance charges and saw Woz's Apple as a marketing opportunity. In that he was right, but it didn't take a lot of vision to see where the microcomputer industry was heading, just a reading of my editorials in *Byte*. By the time Apple was getting started I was already starting *Kilobaud*, my second computer publication.

The Apple computer took off and soon had 40% of the microcomputer market. Radio Shack's TRS-80 had another 40% of the market, and about 200 small companies (all now gone) shared the other 20%. This was the way it was when IBM came into the market with their PC and blew everything up.

Meanwhile, the rift between Jobs and Wozniak was widening. The Woz was pushing to keep on improving the Apple II. Jobs, who'd had little to do with its design, had delusions of grandeur and wanted to invent his own computer. This resulted in the Apple III and the Lisa, two bombs. Woz left in disgust.

The Lisa was based on a new approach to computing that had been developed by Xerox in their Palo Alto Research Center, one which allowed the user to work with icons and menus instead of typed in commands. It was a good approach, making computers much easier for beginners to use. Friendlier. Except that the Lisa was pitifully slow.

The Apple II was based on the 6502 microprocessor, which was pretty good when it came out in 1975, but was getting to be an antique by 1979. The Intel 8080 had been improved with the 8086 and the 8088. Then came the Z80 and the 80186. It was a steady improvement and growth of the basic 8080, and all designed by one chap. The same thing was happening to the 6502, but Jobs wouldn't let the Apple II be upgraded to the 65816, a 16-bit and much faster version. He had a vendetta against the Apple II and Woz, and this doomed the II.

I visited the chap who had designed the 65816 to get some samples for projects I was working on and he had a 65832 all designed and ready for prototyping. This would have run 8, 16, or 32-bit software, it ran at 30 MHz, and had built-in circuits to speed up the disk drives and output to a printer. This chip would have put the Apple II into the minicomputer power bracket. Jobs said no, a decision that cost Apple billions.

When the Lisa laid an egg Jobs rounded up a development team to speed it up. In 1983 he introduced the Macintosh with the usual hoopla. The Mac was much better than the Lisa, but it had almost no application programs, so its acceptance was slow. It was supposedly aimed at the business market, but there were no business programs for it. The first software made use of its graphic abilities and soon was being accepted by artists. The real breakthrough came when desktop publishing software was developed. The Mac still is a stranger in offices, where the IBM format completely dominates.

The mess all this made at Apple resulted in their bringing in Scully, who got rid of Jobs as quickly as he could. But the damage had been done and Apple today has only 13% of the market. If Jobs had let The Woz keep on developing the Apple II the company might have had two winners today, and a few billion dollars more in sales.

There is a wide-open opportunity for either Apple of IBM to take the next logical major step in the market, but with bean counters in the CEO chairs instead of visionaries, the chances of either company taking this step are minuscule. Such a step would quickly leave all the clones behind, knocking many of them out of the business. The step would require the least change for IBM, and could reverse their gradual disintegration. I've written to both of the new CEOs, but have not had any answer.

The step involves the development of industry niche specific computer systems, complete with local service. I've written about this in greater depth in my *20/20 Foresight* pamphlet (#14).

The IBM team which developed the PC saw the importance of third-party support for the Radio Shack TRS-80, so instead of going the old IBM route of a closed operating system, they cooperated with software and accessory suppliers. Radio Shack, meanwhile was still fighting these suppliers, so they dropped their support of Radio Shack and moved to IBM. And that's when the Radio Shack computer share of the market dropped from 40% to around 4%, losing them tens of billions. Radio Shack has never recovered from this blunder by Tandy Chairman Roach.

Now the IBM PC is getting thrashed by clones, but the real long-range disaster for IBM is the loss of the mainframe market to super-micros, as I predicted over 10 years ago. Apple, by keeping their operating system closed, has discouraged software support of business-oriented systems, so even though the Macintosh has been ahead of the PC in graphics and publishing, it's been behind with business applications . . . and that's over 80% of the market. Only a bold step in a new direction by Apple or IBM can reverse these trends. They are both in desperate need of a visionary to keep them from being history.

Number 21 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the March issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

ANNOUNCEMENT

WASHINGTON, DC The Foundation For Amateur Radio, Inc., a non-profit organization with headquarters in Washington DC, plans to administer 56 scholarships for the academic year 1995—1996, to assist licensed Radio Amateurs. Licensed Radio Amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment at an accredited university, college or technical school. The awards range from $500—$2000 with preference given in some cases to residents of specified geographical areas or the pursuit of certain study programs. Additional info and an application form may be requested by letter or QSL card, postmarked prior to April 30th, 1995, from *FAR Scholarships, 6903 Rhode Island Avenue, College Park MD 20740.*

MAR - APR

ST. LOUIS COUNTY, MO The 1995 SKYWARN weather observer training seminars, sponsored by St. Louis County Emergency Management, are as follows: Basic SKYWARN Class: Mar. 21, 7 PM-10 PM; Apr. 10, 7 PM-10 PM; Apr. 22, 9PM-Noon. Advanced SKYWARN Class: Apr. 19, 7 PM-10 PM; Apr. 22, 1 PM-4 PM. Damage Assessment: Apr. 29, 1 PM-4 PM. All classes are open to everyone, and certification is provided. For more info, contact *Mike Redman KA0YXU, P.O. Box 16673, Clayton MO 63105. Tel. (314) 889-2362.*

MAR 5

CLEVELAND, OH The Cleveland Winterfest will be at the Cuyahoga County Fairgrounds, Berea OH, 8 AM-2 PM. Set-up at 6 AM. VE Exams will be administered early; bring proper IDs, a copy of your license, and a check payable to ARRL/VEC. DXCC/WAS QSL Checking. Talk-in on 146.73. Contact *Hamfest Assn. of Cleveland, P.O. Box 81252, Cleveland OH 44181-0252. Tel. (800) CLE-FEST (253-3378)*; or *999-7388* in the Cleveland area.

MAR 10

ST. LOUIS, MO The Jefferson Barracks ARC will host their 35th annual Ham Radio Auction starting at 7:30 PM at Concordia Turners Hall, 6432 Gravois Ave. Talk-in on 146.34/.94 or 144.61/145.21. Contact *Carl H. Hohenberger WB0BZP, 5266 Parker Ave., St. Louis MO 63139-1340. Tel. (314) 351-7084.*

MAR 11

FARGO, ND Red River Radio Amateurs will present their Amateur Radio/Computer Electronics Fair at the West Fargo Fair Ground, 8 AM-3 PM. VE Exams start at 1 PM; pre-registration required. Talk-in on W0ILO 146.76(-). Contact *A.R.C.E.F. '95, P.O. Box 3215, Fargo ND 58108-3215.*

MAR 11-12

CHARLOTTE, NC The Mecklenburg ARS welcomes you to the 1995 Charlotte Hamfest/ComputerFair and ARRL Roanoke Div. Convention. Location: Charlotte Merchandise Mart, 2500 E. Independence Blvd., in Liberty Hall, (US 74). Hours: Sat. 9 AM-5 PM; Sun. 9 AM-2 PM. VEC FCC Exams Mar. 12th; pre-register, or walk-ins accepted as space permits. Contact *Charlotte Hamfest, P.O. Box 221136, Charlotte NC 28222-1136. Tel. (704) 841-HAMS.* Talk-in on W4BFB, 144.69/145.29.

MAR 12

BRISTOL, CT The Insurance City Rptr. Club Inc. will hold its annual Hamfest Flea Market from 9 AM-1 PM (snow date Mar. 19th), at Bristol Eastern H.S., King St. (RT 229). Talk-in on 146.88 and 224.80. To reserve tables, send an SASE to *Al Gerke N1JWF, 63 N. Washington St. Apt. 2, Plainville CT 06062-1921*; or call *(203) 747-1925.* VE Exams at 10 AM; no walk-ins. To register, send an SASE to *ICRC, P.O. Box 165, Pleasant Valley CT 06063.*

INDIANAPOLIS, IN The Indiana Hamfest & Computer Show will be held at Indiana State Fairground's Pavilion Bldg., by the Morgan County Rptr. Assn. Doors open at 8 AM. Talk-in on 147.06. For table reservations or info, send an SASE before Feb. 21st, to *Deanne Martin N9TEJ, 39 Lake Shore Dr. #14, Martinsville IN 46151. Tel. (317) 342-4307.*

MAR 18-19

MIDLAND, TX The Midland ARC will hold their annual St. Patrick's Day Swapfest Sat. from 9 AM-5 PM; Sun. 8 AM-2:30 PM at Midland County Exhibit Bldng. Flea Market. T-hunts. VE Exams at 12 PM Sat. Contact *Midland ARC, P.O. Box 4401, Midland TX 79704.*

MAR 19

JEFFERSON, WI The Tri-County ARC annual Hamfest will be held at Jefferson County Fairgrounds, starting at 8 AM. Set-up at 7 AM. Contact *W9MQB, 213 Frederick St., Fort Atkinson WI 53538. Tel. (414) 563-6381 eves.*

LEXINGTON, MA A Ham Radio Fleamarket will be held at Westboro MA H.S., by the Minuteman Rptr. Assn., 10 AM-2 PM. Set-up 8 AM-10 AM. Walk-in VE Ex-

ams (ARRL-VEC) at Noon. Contact *Walter N1HBR, P.O. Box 2282, Lexington MA 02173. Tel. (508) 489-2282.*

NORTH TARRYTOWN, NY WECAFEST 1995 will be held 9 AM-2PM by the Westchester Emergency Comm. Assn. Location: Yonkers Raceway (Intersection of I-87, Central & Yonkers Ave., Yonkers NY. Talk-in on 147.06/.66. Contact *Tom Raffaelli, (914) 962-9666.*

STERLING, IL The Sterling-Rock Falls ARS 35th annual Hamfest will be held at Sterling H.S. Field House, 1608 4th Ave. Radio, electronic, computer, and hobby Flea Market. Doors open 7:30 AM. Setup Sat. 6 PM-9 PM; Sun. 6:30 AM. Talk-in on 146.25/.85 W9MEP Rptr. Contact *Lloyd Sherman KB9APW, Sterling-Rock Falls ARS, P.O. Box 521, Sterling IL 61081-0521. Tel. (815) 336-2434.*

MAR 25

ELIZABETHTOWN, KY The Lincoln Trail ARC will sponsor a Hamfest 8 AM-4 PM at Pritchard Comm. Center. Setup Fri. 7PM-9 PM. Talk-in on 146.98. Contact *Whitey Hensley, P.O. Box 342, Vine Grove KY 40175. Tel. (502) 877-2234.*

MICHIGAN CITY, IN The Michigan City ARC will sponsor their annual Hamfest/Computer Show at Rogers H.S., 8466 Pahs Rd., 8 AM-2 PM. Setup at 6 AM. VE Exams. Talk-in on 146.97(-) 131.8 PL. Contact *Ron Stahoviak N9TPC, 213 S. Dickson St., Michigan City IN 46360. Tel. (219) 872-6594.*

TEXARKANA, TX A Hamfest will be held at Texarkana College Student Center 7 AM-6 PM. VE Exams. Set-up Fri. after 6 PM. Talk-in on 146.620. Contact *Four States ARC, c/o Bill Wilson KB5WDV, #34 Dustin Terrace, Nash TX 75569. Tel. (903) 832-5644.*

MAR 26

MONROEVILLE, PA The Two Rivers ARC will hold its 23rd annual Hamfest/Computer Show at the Pittsburgh Expomart (Eastwing) on Business Route 22. Forums. Talk-in on 146.73 and 147.12. Check-in (good for a prize) on 146.52. For tickets, tables or info, send a business size SASE to *Two Rivers ARC, P.O. Box 225, Greenock PA 15047-0225. Phone/Fax: (412) 754-0562.*

APR 1

NORWICH, CT A Saturday Ham Radio Auction will be sponsored by the Radio Amature Soc. of Norwich, beginning at 10 AM. Setup at 9 AM. Talk-in on 146.730(-). Bring your gear to sell. For details, call *Tony AA1JN, (203) 859-0162;* or *Mike N1HFX, (203) 546-9498.*

TEANECK, NJ The Chestnut Ridge RC will hold its annual Flea Market, 8 AM-2 PM, at the Saddle River Reformed Church Education Bldg., East Saddle River Rd., corner Weiss Rd., Upper Saddle River NJ. Talk-in on 146.955 Rptr. Contact *Jack Meagher W2EHD, (201) 768-8360.*

APR 2

MADISON, WI The 23rd annual Madison Swapfest, sponsored by the Madison Area Rptr. Assn., will be held at the Dane County Expo. Center Forum Bldg. Doors open at 8 AM. Setup at 7 AM. Ask about special Sat. set-up time. Talk-in on the M.A.R.A. Rptr. WB9AER, 147.75/.15. Reservations deadline is Mar. 20th. Contact *M.A.R.A., P.O. Box 8890, Madison WI 53708-8890.*

TRENTON, NJ The 23rd annual Hamfest "Hamcomp '95" will be sponsored by the Delaware Valley Radio Assn. at Trenton State College. Admission at 7:30 AM. Setup at 6:30 AM. Talk-in on 146.67(-) and 442.650(+). For info contact *HAMCOMP '95, DVRA, P.O. Box 7024, West Trenton NJ 08628. Tel. (609) 882-2240.*

APR 8

LAWTON, OK The Lawton Ft. Sill ARC will hold the 49th annual LFSARC Hamfest 8 AM-5 PM at the Comanche County Fair Grounds. Talk-In on 146.91/.31. Contact *Bob Morford KA5YED, 1415 N.W. 33rd St., Lawton OK 73505;* or *(405) 355-6120.*

PICKERING, ONT. CANADA The Durham Region AR Hamfest will be co-hosted by the South Pickering ARC and North Shore ARC at the Metro East Trade Centre. Talk-in on 147.375/.975 and 147.120/.720. Contact *David Herve, South Pickering ARC, P.O. Box 53, Pickering ON L1V 2R2. Tel. (905) 837-2127;* or *FAX (905) 831-5556.*

SPECIAL EVENT STATIONS

MAR 11

KINCARDINE, ONT. CANADA Station VE3LPE will operate 1400Z-2200Z to commemorate the birthday of Albert Einstein, and the peaceful use of nuclear energy. Operation will be in the lower portion of the General 80, 40, 20, 15, and 10 meter subbands. For a certificate, send QSL and a 9" x 12" SASE to *Kevin Pickles VE3LPE, 638 Johnston Cresc., Kincardine, ONT N2Z 1S7, Canada.*

MAR 12-13

WATERFORD, WI The 1995 Wisconsin QSO Party will be on the air 1800Z Mar. 12-0100Z Mar. 13. Entries must be postmarked by Mar. 31st, 1995. Contact *Wisconsin QSO Party, West Allis RAC, P.O. Box 1072, Milwaukee WI 53201* for complete details.

MAR 18

MACON, GA The Macon ARC will operate W4BKM 1400Z-2300Z at the 13th annual Cherry Blossom Festival. Phone: 7.235, 14.235, and 21.335; CW: 7.135, 14.035, and 21.135. For a certificate send QSL and a 9" x 12" SASE to *Macon ARC, P.O. Box 4862, Macon GA 31208.*

MAR 18-19

PISCATAWAY, NJ Members of the Piscataway ARC will operate "VOA" starting Mar. 18th at 0000 UTC-2400 UTC Mar. 19th, to commemorate the WWII operation of the Voice of America relay station WBOU. CW: Novice subbands. Phone: Lower third of the General 80—15 meter subbands and the Novice 10 meter subband. RTTY operations will be conducted on 80, 40, and 20 meters. For a certificate, send QSL and a 9" x 12" SASE to the station worked.

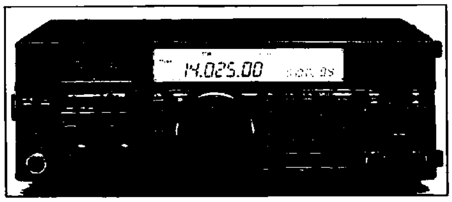
APR 8

STREATOR, IL The Streator ARC will Operate Station K9CAU to commemorate the 50th Anniversary of the Streator Hobby Show. Operation will be from 0900 UTC-2300 UTC on the 40 and 20 meter General phone band. For a certificate, send SASE to *N9PLM, 1705 Florence St., Streator IL 61364-1337 USA.*

Number 22 on your Feedback card

NEW PRODUCTS

Compiled by Charles Warrington WA1RZW



ICOM

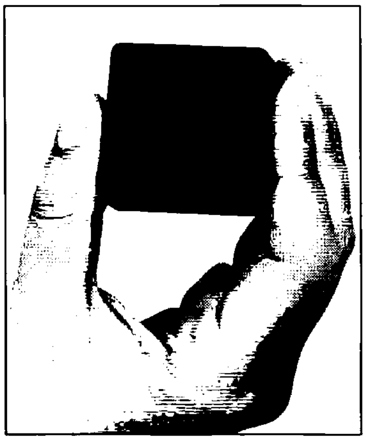
Work all the HF bands and receive 300 kHz to 29.995 MHz with Icom's *next generation* IC-738 transceiver. SSB, CW, AM, and FM are built into this rig, which provides a full 100 watts output (40 watts in FM). A heat sink with two large cooling fans ensures stable 100% duty cycle operation—great for DXing marathons.

The IC-738 incorporates *next generation* circuitry with Icom's unique Direct Digital Synthesizer (DDS) IC. High-tech and compact, the PLL unit provides precise frequency resolution to 1 Hz. Other features include built-in antenna tuner, Double Band Stacking Register (DBSR), three scanning functions, passband tuning (PBT), and a notch filter.

The suggested retail price for the IC-738 is $1,935. For more information, please visit your favorite dealer or contact *ICOM America, Inc., 2380-116th Avenue N.E., Bellevue, WA 98004; (206) 454-8155.* Or circle Reader Service No. 201.

CCTV

CCTV Corporation has announced the introduction of the GBC CCD-600PH Pincam. This new camera's revolutionary design allows users to place the camera virtually anywhere for completely undetectable surveillance and many ATV applications. The camera is 1-1/2"W x 1-1/2"D x 3/4"D. The Pincam's ultra-miniature size is enhanced by the built-in 3.6mm or 5.5mm pinhole lens.



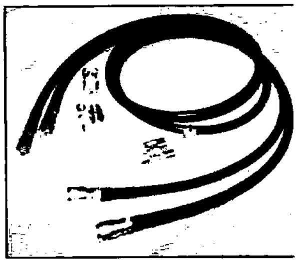
This camera's built-in electronic shutter automatically compensates for lighting changes. Simply mount the camera behind a 1/16" hole to obtain a clear picture. The Pincam's resolution is over 400 lines, with a sensitivity of 0.2 lux. For more information contact *CCTV Corp., 280 Huyler Street, South Hackensack, NJ 07606; (201) 489-9595, (800) 221-2240, FAX (201) 489-0111.* Or circle Reader Service No. 206.

AEA

Advanced Electronic Applications has begun shipping the new AEA FAX III. The AEA FAX III is a stand-alone, multi-intensity, gray-scale, HF weather fax demodulator and display software package. This product allows amateurs to colorize received weather fax images. This pseudo-color feature allows users to choose from 256 colors to clarify images or just to make them more appealing. Export to GIF or PCX files for manipulation in other graphics programs, then include them in newsletters, letters, or other publications.

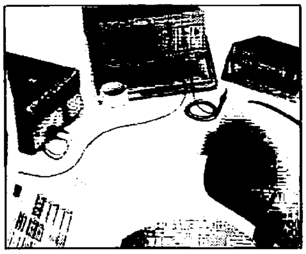
This IBM-compatible software receives satellite maps and WEFAX images in 16 levels of gray. It also receives and decodes CW, RTTY, and NAVTEX transmissions. There are many more features, too. The suggested retail price is $149. For more information, please visit your favorite dealer or contact *Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood, WA 98036; 206-774-5554, FAX 206-775-2340.* Or circle Reader Service No. 207.

CABLE X-PERTS



CABLE X-PERTS has a new 1995 catalog available for interested amateurs. This catalog provides a lot of technical information on coax cable and related products, prices included. In addition, CABLE X-PERTS has a solution for hams who have difficulty installing PL259 or N type connectors. The company will install these connectors at $5 per connection plus the cost of the connector on any of their coax cables (except LMR series). All connections are soldered, HI-POT tested, continuity checked, and sealed with UV-resistant heat-shrink tubing. Normal turnaround time is 10 business days.

For a catalog, please mail a Self-Addresed Stamped Envelope (SASE. For more information contact *CABL X-PERTS, Inc., 113 McHenry Rd Suite 240, Buffalo Grove, IL 6008 1797; (800) 828-3340 (orders only (708) 506-1886 (technical info), (70 506-1970 (FAX).* Or circle Reade Service No. 204.



TEKTRONIX

Tektronix, a leader in oscilloscope technology and instrumentation for nearly 50 years, has introduced a complete portfolio of products called TekBench, representing high-value low-cost products. More than 40 differ ent basic test and measurement prod ucts are available in the TekBenc portfolio, including oscilloscopes, func tion generators, universal counter and counter/timers, bench-top multi meters, power supplies, and measure ment accessories.

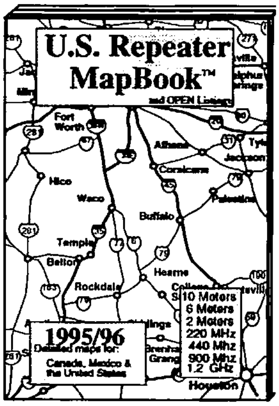
All TekBench instruments are com patible, fully integrated, and have uniform look and feel for simple, eas use by folks with a wide range of tech nical skills. For the name of an autho rized dealer call 1-800-426-220 (press "1" when prompted). Or contac *Tektronix, P.O. Box 500, Beaverto OR 97077-0001.* Or circle Reader Se vice No. 203.

MFJ

MFJ Enterprises has introduced the MFJ-114 12/24-hour 2.3" LED digit clock. This clock is so large it could time a football game, but it is really made for the ham shack. It features giant 2.3" red LED digits—nearly the width of a 2 meter handheld. The display is especially bright, too.

The MFJ-114 can be mounted to the wall or the ceiling, and the clock is easy to operate. It is powered from house current and features a battery backup. The price is $39.95. For mor information or to order, visit your fa vorite dealer or contact *MFJ Enterpris es, Inc., P.O. Box 494, Mississipp State, MS 39762; (601) 323-586 FAX (601) 323-6551, or toll free 80 647-1800 (orders only).* Or circl Reader Service No. 205.

ARTSCI



ARTSCI's *1995/1996 U.S. Repeater MapBook* is the perfect traveling companion for the radio enthusiast. This 5th edition has been totally redesigned to better serve the traveling amateur. New highly detailed maps enhance the presentation of the popular amateur repeaters. In an effort to show every open repeater, a detailed city-by-city listing accompanies every state map.

Maps show all major highways and cities in each state. New in this year's edition are table listings of all open repeaters in each state. Ask for the new *MapBook* at your favorite dealer or contact *ARTSCI Inc., P.O. Box 1428, Burbank, CA 91507; (818) 843-4080, FAX (818) 846-2298.* Or circle Read Service No. 202.

BARTER 'N' BUY

Number 23 on your Feedback card

Turn your old ham and computer gear into cash now Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that ng you're not using now Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Joyce Bocash, *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the May 1995 classified ad section is March 9, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd **USA**. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

DWYER WIND SPEED INDICATOR only $55.00 plus $4.00 S/H. For home or office. Accurate, low-cost, practical. Roof mounted pickup. Send check or M.O. to: **RAD-MON COMPANY**, Dept A, Box 751, Marathon NY 13803-0751. (NY Residents add Sales Tax) BNB285

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO**, 10715 SW 190th Street #9; Miami FL 33157. (305)238-3327. BNB295

WANTED: Electron Tubes, ICS, Semiconductors. **ASTRAL**, P.O. Box 707ST, Linden NJ 07036. Call (800)666-8467. BNB307

KENWOOD AUTHORIZED REPAIR. Also **ICOM**, Yaesu. **GROTON ELECTRONICS**, Box 379, Groton **MA** 01450. (508)448-3322. BNB310

UNIQUE INDOOR/OUTDOOR ANTENNA gives 30 dB gain on 160m-10m. Plans: $6.95. **BOB CHRISTIE AA2KE**, 215-28 Spencer Ave., Queens Village **NY** 11427. BNB319

NOW ON 80 METERS! New, knob-tuned w/digital display, synthesized QRP transceiver. Complete kit only $199.95. S&H $6.50 (continental US). **GUARANTEED TO WORK.** For info send SASE: Call/write to order: **S & S ENGINEERING**, 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

Continued on page 82

PROPAGATION

Number 24 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

HF propagation this month is expected to be Poor (P) or Very Poor (VP) on the days 9-12 and again 15-17. The Good (G) days for DX are likely to occur during the first five days and the last two weeks of the month. The remaining days will be days of transition.

Although March is traditionally a good month for DX because of the approaching equinox and increasingly favorable springtime ionization of the upper atmosphere, we are now approaching the lowest part of Sunspot Cycle 22 . . . expected in late 1995 or early 1996. That means less overall ionization and fewer opportunities for worldwide HF communication, particularly on the 17, 15, 12 and 10 meter bands. Better directional antennas and a careful choice of operating hours will be required to maximize DX opportunities.

10 and 12 Meters

Occasional F2 openings to the Southern Hemisphere during daylight hours. The bands close at sunset.

15 and 17 Meters

Consistent openings to Africa and Latin America, and short skip to about 1,000 miles during daylight. Bands close at sunset or shortly after.

20 Meters

Your best band for DX to all areas of the world between sunrise and well past sunset, and short skip to 2,000 miles during daylight hours.

30 and 40 Meters

Good DX from slightly after local sunset to just before local sunrise. Signals from the east peak between sunset and midnight, and from all other areas between midnight and sunrise. Daytime short skip to 1,000 miles, and nighttime skip to 2,500 miles.

80 and 160 Meters

Good DX from sunset to sunrise on nights of low atmospheric noise, and skip to 2,000 miles or so. Requires vertical transmitting antennas and horizontal (preferably Beverage) antennas for best results on receiving. Little, if any, daylight activity on 160, but some on 80 meters.

Final comments require me to warn of possibly violent weather and other geophysical occurrences centered around the 9th and 10th, and again around the 16th and 17th. Hang on to your hats! As always, check WWV at 18 minutes after any hour for the latest updates on propagation. See you here next month.

MARCH 1995						
SUN	MON	TUE	WED	THU	FRI	SAT
			1 G-F	2 F	3 F-G	4 G-F
5 F	6 F	7 F-P	8 P-VP	9 VP	10 VP	11 VP-P
12 P	13 P-F	14 F-P	15 P	16 P-VP	17 VP-P	18 P-F
19 F	20 F-G	21 G	22 G-F	23 F	24 F-G	25 F-G
26 F-G	27 G	28 G	29 G	30 G	31 G	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
AGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

73 Amateur Radio Today

APRIL 1995
ISSUE # 415
USA $2.95
CANADA $3.95
A WGI Publication
International Edition

Build an Antenna Elevator!

An Efficient Mobile HF Vertical

Home-Brew Top Band Receiving Antenna

Remote Control Intelligent Relay

73 Reviews

Gap Voyager DX

Yaesu's Mil-Spec Mobile

0 74820 08725 1

THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

MANAGING EDITOR
Hope Currier

SENIOR/TECHNICAL EDITOR
Charles Warrington WA1RZW

EDITORIAL ASSOCIATE
Joyce Sawtelle

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Charles Warrington WA1RZW

GRAPHIC DESIGN
Suzanne Cote

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

GRAPHICS MANAGER/ PAGINATION
Linda Drew

CIRCULATION
To subscribe: 1-800-677-8838

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

April 1995
Issue #415

FEATURES

REVIEWS

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

An infrared view of earth as received at 1200Z on Sunday, 10 July, 1994, off Meteosat 5 as nine separate pictures. The pictures were combined on a Macintosh using Adobe Photoshop. To learn more please turn to "A Practical Weather Satellite Receiving System, Part 2," on page 10.

On the cover: Antenna work can be a thrill at 300+ feet in the air! Here is a shot of antenna work being done on the W5TSV club repeater tower in Pampa, Texas. A one-year subscription/extension goes to Ken Payton KB5RQV in the 73 Photo Search.

FB

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: Read any good books lately? Quit stammering, and turn to Uncle Wayne's Bookshelf on page 94. It's about time for you to start stimulating your gray matter with a good book!

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Mac or PC?

Sherry pointed something out to me that was so obvious that I felt stupid for not noticing. She asked why I'm not running more computer articles in *73*? Hmm. Why indeed? As soon as she asked, it hit me. At the Virginia Beach hamfest over half the exhibitors were selling computer stuff. Even at Dayton the number of computer exhibitors has been growing and growing. And the flea market is packed with computer stuff. Yes, hams are buying computers, drives, software, boards, and parts. They're buying them big time.

I remembered back to 1975, when the first microcomputers came on the market and the enormous interest the ton of computer articles I published in *73* generated. Later I reprinted the articles in a book on computer basics and it sold like gangbusters.

Today I doubt that one ham shack in 50 is completely without a computer. We use 'em for logging, for copying CW, RTTY, slow-scan, packet, AMTOR, ham satellite antenna aiming, and so forth. We use 'em to design circuits, antennas, draw schematics, etc.

Now what all that means is that I want to see a whole lot more articles being submitted on using computers in amateur radio. I want to see them for PCs and Macs. I want construction articles on making boards to help us do our dirty work. And on ways to modify existing boards for amateur applications, or even other things around the home that might at least ingratiate the XYL and make her slightly more tolerant of your hobby.

73 readers are interested in user reports on ham-oriented software and accessory boards, so when you try something new, keep notes. With more stuff appearing on CD-ROMs, such as the *Callbook*, we all want to keep up with anything relevant to our interests on CD-ROMs.

How about converting older computers so they can use current software? Is there any way to update an old TRS-DOS or CPM computer so it can live in a PC environment? Or are all those old computers just boat anchors now? There are hundreds of thousands of them kicking around, so if there's some way to update them we'd have a great supply of cheap computers for our shacks.

How hard is it to upgrade old 8086 PCs to a 386? Or better? Is it practical?

Maybe you could survey the computer exhibits at the next hamfest you attend and send me a report on what you've found that look like bargains, and what you think are rip-offs.

If you get a chance, take a good look at the *73* I/O sections in the mid-'70s and you'll see how much hams were into computers then. Well, it's 20 years later and the only thing that's changed is that hams today have even more interest in computers than they did a generation ago. When a May 1976 issue turned up the other day I checked and found we had 25 pages of computer articles. Plus my page and a half I/O section editorial.

What's That Damned Noise?

It's Opportunity, banging away at your door, so why are you sitting there wasting your time when you could just as well be making money? A ton of money? Of course, I'm probably irritating you about this money thing because you have undoubtedly already organized your life so you are working at a job you really enjoy and making more than enough money to do just about anything you want. However, if this is true, it sure isn't reflected in the mail I'm getting.

I got to thinking about this when I saw two mail order companies selling a product which I'd recommended you think about as a commercial product when I published the schematic and details in an article 19 years ago. Okay, so I was ahead of my time again. This is a great little device which jams police radar signals. And, the best part, it's a device which does this legally!

The article appeared in the Holiday 1976 issue, pages 32-35. In the introduction I explained that this simple unit could be home-built for around $10 and should sell like crazy at $49.95. It's on the market now for $100, which is about the same as $50 twenty years ago.

So what is it that gets some people to think as entrepreneurs, while others just trudge along from day to day, living lives of frustration and "quiet desperation?" The world provides plenty of entertainment to help us while away our lives instead of using our time to make more money and maybe provide some products or services which will help the world to progress. For entrepreneurs, I should put those two benefits in the reverse order.

Articles in the business magazines by writers who have studied entrepreneurs tell us there are some common factors. For one, none of the really successful entrepreneurs have gone into business with the primary goal of making money. They are usually interested in doing something which they feel needs to be done. Sure, they know they have to organize their enterprise so it will make money if they are going to accomplish anything, but that's secondary and a nuisance.

Few successful entrepreneurs bother to finish college. They are too impatient. They discover that they aren't getting a good value for the time they are spending. They figure out that all a college education can really do is provide a basis for future learning. It's only a ticket to learn. It's a ridiculously expensive, time-wasting ticket.

The radar jamming unit is simple. It consists of an antenna tuned to the radar frequency which reflects the radar signal back with a stronger reflection than your car produces. In the antenna is a diode which modulates the reflected signal and fools the police radar unit into indicating whatever speed you want it to indicate. Since there is no transmitter, the device does not require a license and is thus completely legal to use. It's a nice countermeasure.

An entrepreneur would look at the article and see an obvious public need, and thus an opportunity. As I pointed out in the first paragraph of my introduction to the article, " . . . the main reason for publishing this article is that it is an example of applying ham techniques to make commercial products. As a detector of police radar, one which returns a strong echo modulated to indicate whatever speed you wish, it is possible that a *lot* of these could be sold."

It doesn't take a lot of money to start a small manufacturing business. When I decided to start making loudspeakers in 1951 I went to the bank, borrowed $1,000 on my car, and got a small wood shop to make a few units for me. Within two and a half years I had five factories working full-time to fill my orders and I was the largest manufacturer of loudspeakers in the country. In terms of today's dollarettes I was selling about $20 million worth a year. There goes Wayne, bragging again, right? No, it's really not that. I just want to show you that I'm not writing puff and baloney. I've been there, done that. I'm trying to encourage you to do things by proving they can be done because I've done them. Like the time I dieted 20 years ago and took off 85 pounds . . . and have kept it off.

There are endless businesses you can start in your spare time with only a modest investment. But you have to keep your eyes open and your imagination tuned for opportunities. I was lucky in that my mother's father was an inventor. A successful inventor. He's the one who helped Henry L. Dougherty get going in the oil business . . . now known as Citco. He's the one who stepped in and reorganized Continental Can Company with innovative new products during the depression, thus keeping it from going under. It's doing fine today. He was a good role model.

My father was an entrepreneur too. He saw the opportunities in the flying business, so he learned to fly in 1921. He did the usual barnstorming at first, did the first study of American airports for the Department of Commerce, built Central Airport for the Philadelphia area, started the first transatlantic airline, and so on. We're working on reprinting his Ancient Aviator articles from *73* in book form.

My friend Joe Sugarman W9IQO saw an opportunity to sell electronic gadgets to yuppies and made millions with his JS&A mail order operation. He's now doing just fine selling BluBlocker glasses via TV infomercials.

Once you tune your mind to it, there are endless entrepreneurial opportunities. I started my first business when I was 13. I was into stamp collecting and I noticed that there was an interest by collectors in buying bulk stamps, so I went into business as the Elm Stamp Company. I bought 100-pound bags of stamps, repackaged them in five- and ten-pound boxes, and built a nice little business. That was just before I got interested in radio at 14, which then took over my time. It still does.

It's frustrating for me to see people wasting their time watching sports, soaps, sitcoms, and on idle gossip on 75m or QSL-hunting on the higher bands. With so many entrepreneurial opportunities out there, why leave little more than a headstone and a few poorly brought up children as your only legacy?

To find opportunities you need to read. There are products and services needed in just about any field you look

Continued on page 82

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Lowell White KA9AMJ, Roanoke TX Wayne, after reading the January 1995 issue I felt it was certainly time to write.

The review of the Yaesu FT-840 was right on! I bought one six months ago as a replacement for an old rig that I'd had and liked a lot.

I consider the FT-840 superior as being DDS rather than PLL, and having a backlit LCD display rather than the impossible-to-read-in-the-sunlight green gas tubes in the old rig. Having more memories in it doesn't hurt, either. The *key* factor in my buying the radio was its ability to store band segments into tunable memories. That allows us mobile HF operators to use the tuning within the memories instead of the VFOs—conveniently keeping us from tuning out of band (or license privilege frequency range) without having to watch the display like a hawk. That's a *major* plus while mobile in city traffic. Unfortunately, even the Yaesu reps at Ham-Comm (Arlington, Texas) weren't aware of the radio having this feature. One specifically said it couldn't do it—though their own literature indicated it could. Hmmm.

The construction article on the 10 meter Pyramid Antenna was good—I may consider building one. I currently have a couple of five-element yagis that will get preference, though. My main desire is for a *good* mobile antenna that is short enough to go into a parking garage and still produce a walloping signal. So far the best antennas seem to be *way* too tall and/or expensive. I've got some ideas so maybe I'll hack at that. Maybe Mr. Bilal (Bilal Company) has an answer.

Best of all in this issue was (as often is the case) your editorial. You are one of the few folks that I can consistently rely on to prod your readers into being *active* in getting something done aside from existing—or at least cognizant that there is more to life.

I have often wondered about gravity waves and related phenomena. It seems that the ability to measure them, let alone the ability to shield/dilute them or enhance them, could be very valuable. Imagine the impact that could be had in the fields of transportation, security, and likely in manufacturing processes, too.

Spread spectrum transmission is an appealing thing, too, especially thinking about how it parallels with the ISDN services the communications and now computer industries are trying to get a handle on. Maybe we need to come up with a better way to make it more accessible for fewer dollars. Maybe use a lesser adaptation to automatically shift transmission frequencies to take advantage of better propagation and save a few watts of power while getting just as good or better transmission quality (fewer resends and better signals).

I have an idea also to maybe offer a competitive service to the now-ineffective patent system. I've learned techniques that our "friends" in foreign markets use to make the patent system work against us (the U.S.). Maybe an alternative system—with appropriate court representation (ugh!) is what's needed. Why not privatize it? Compete with the existing one? As you know, the individual with a brain can outperform the "gummint" any day for efficiency and productivity. Why else do we keep getting charged more for a letter to be mailed more slowly when at the same time it's getting cheaper to connect to the Internet and send pictures, video, sound and text in a matter of seconds (or, at worst, minutes)? I've personally resolved to use the snail mail for increasingly *less* of my correspondence and use E-mail *more*.

Thanks for a great mag. I subscribe to *Radio Fun* also. I like to read through it, get the "news," and have a good sampler to pass on to prospective hams. It's a good recruiting tool.

"Thanks for a great mag. I subscribe to Radio Fun also. I like to read through it, get the 'news,' and have a good sampler to pass on to prospective hams. It's a good recruiting tool."

George M. Crewe VE3TPD, Wheatley, Ontario, Canada Wayne, I have enjoyed your column and your magazine over the years. I have only been licensed for three years but I have been a reader of *73* since I was old enough to read.

My dad was a subscriber to *73* for a year or two back in the '50s. He had always wanted to become a ham but for whatever reason he could never seem to master CW. Being a commercial fisherman and boat builder, he was very busy and lack of time, I guess, was a factor.

After WWII, there was a pile of surplus equipment available and he acquired quite a bit of it with the purpose of building an AM marine band rig for his boat. Advanced theory would not have been his problem as he quickly came up with a converted 19 set to fill the bill. Although as illegal as could be, that rig did the job of adding to the safety of a lot of people for about three years until he finally got a license and a legal rig. When someone was in trouble and needed help, he was one of the first to come to their aid, regardless of the weather.

I still have an old Marconi RCAF transmitter of his which I hope to put on the air on 80 meter CW. I love old equipment. My main HF rig is an old EICO Model 753 (7 drifty 3). I also run an old Galaxy III on 80 meter CW. I have an old Marconi Marcomm II that I stripped the innards out of and converted to CW on 80, 40 and 30 meters. An old Marcomm III fills the bill for some light operation on 160 meter AM phone. To put the whole thing into focus, I spent a lot of time looking over Dad's shoulder as he built those Heathkits and tuned those old Marconis on the boat.

Dad was someone who worked hard all year and when summer came he left his business to those who worked for us and toured the Great Lakes system in his 54-foot cabin cruiser. For six weeks home was anywhere between here and Thunder Bay. Once north of the Soo, radio stations were few and far between. This is where I came to enjoy SWL and broadcast band DXing. During the day the BBC and a number of other SW broadcasters filled the bill. At night it was nothing to pick up stations like WBZ in Boston or WABC in New York. This was a hobby which I had come to enjoy at home and still do today.

Back in 1981, I took a radio-TV servicing course with the National Radio Institute. For the better part of 10 years I serviced TVs and radios part-time. They always told us in school that people never complete correspondence courses. I have two diplomas that say they're wrong. Working full-time as a quality control inspector in a factory and working on the side got a little tiring. Three years ago I decided to get back to enjoying electronics as a hobby and not a job.

Last fall I decided to get back to school again. This time the subject was broadcasting. Back in 1962 the broadcaster and actor Lorne Greene started the National Institute of Broadcasting in Toronto. I am proud to be a graduate of their radio and TV broadcasting course. Last year I had the pleasure of chatting with an old friend of Greene's on 12 meters. He had known Greene for a number of years and it kind of put the icing on the cake. He mentioned the Institute, but was unaware that America's famed "Ben Cartwright" had worked for the CBC for a number of years before moving stateside. The late Mr. Greene had run a commercial promoting amateur radio on CBC television which ran up to a year after his death. His legacy lives on and the broadcasting school that he started is bigger than ever.

In a recent column you mentioned that you were considering producing a talk show on radio. Great stuff! We need all of the public awareness we can get. Radio Havana does it with Arnie Coro, so why not do it over here? I had the pleasure of working Arnie a couple of years ago on 6 meter phone and all of the time I kept wondering where I had heard his voice before. Upon recalling his radio program I remember thinking that I never dreamed I would get to talk to him in person. Ham radio has introduced me to a lot of really neat people.

Kudos on your work with cold fusion. This is something which I believe will forever change the way we live. There are too many people (complacent individuals and willfully ignorant) who continue to say that it can't be done. These are the same type of individuals who said that we would never reach the moon, travel faster than sound, fly, or send messages without wires. It will be done, and it will be done even more efficiently now because of things like the Internet, which enables researchers to access each other's findings and compare notes.

73 for now, and keep on writing.

Dave Horsfall VK2KFU, Wahroonga, NSW, Australia As I write this, Australian amateurs are up in arms over a proposal that will nearly double our license fees—I have never seen so much packet radio traffic! Our annual fee is currently AU$37 (it was $36 last year), and late in December, just before Christmas, the SMA (Spectrum Management Agency) announced that a new charging scheme will be introduced from March 1st, which will have the effect of nearly doubling the fee to $69 or more.

Some peculiar logic (even for public servants) is used to justify this, and it seems the "user pays" principle has finally reached the Amateur Radio Service. There are three components to this new fee: Issue/Re-Issue, Spectrum Maintenance Tax, and Spectrum Access Tax. The SMA claims that it costs $140 to first issue a license, and as Amateurs apparently keep their licenses for 10 years this is amortized over that period, which when added to an apparent renewal cost of $11, leads to a re-issue fee of $25. The Spectrum Maintenance Tax is explained (and I quote): *"The Spectrum Maintenance charge is the proportion of costs of the on-going work of the SMA."* We think this means that the sunspots have to be cleaned every so often. The Spectrum Access Tax is based upon the principle of "spectrum denial," which is to say that Amateurs are using frequencies which could be used by other services; a figure of $35 was arrived at by measuring the amount of spectrum allocated to Amateurs (on a sliding scale where UHF is worth more than HF) and dividing it by the number of licensed Amateurs.

I wish this was an April Fool joke, but I am not kidding; the general feeling of Amateurs is that our national body, the Wireless Institute of Australia, has let us down, and Amateurs are being exhorted to write letters to politicians, the media, etc.

Here is some food for thought: Last October, CB fees were dropped entirely, as apparently it was not worth the bother of chasing unlicensed operators; at a then fee of $18 the 358,699 licensed operators (as of June 30th 1993) netted the government a total of $6,456,582. At the same time, the 18,142 licensed Amateurs provided $634,970. Are Amateurs being made to pay the shortfall?

QRX . . .

Number 3 on your Feedback card

FCC Releases Vanity Rules

The Federal Communications Commission has released the details of its plan to implement so-called vanity callsigns to radio amateurs. The commission's new computer system will continue to assign call letters in the traditional consecutive sequence; however, soon the FCC will be able to accommodate those who desire a callsign of their own choosing according to a system of four starting gates:

Gate one would allow a previous holder of a callsign to apply for that callsign, or if the holder is deceased, a relative could apply.

Gate two would allow the 66,000 Amateur Extra Class operators, having passed the most difficult of amateur exams, to apply.

Gate three would allow the 112,000 Advanced Class operators, having passed the second most difficult exam, to apply.

Gate four would open the system to any licensee, including a club station license trustee, to apply for the callsign of a deceased former holder.

The FCC is expected to announce the opening of each gate by means of a public notice. First, the commission must prepare the new application—Form 610-V. The Notice of Proposed Rulemaking for the personalized calls was adopted way back on December 13, 1993. A fee is expected to be charged for the privilege of holding a vanity callsign. *TNX W5YI Report, Feb. 1, 1995.*

Emergency Center To Link Ham Radio With Internet

Plans for what organizers call "the world's first public emergency communications center" have been announced by a Colorado amateur. John Hart NØOCF of Lakewood, Colorado, says he is starting the "E-COMM" communications center as a non-profit organization to link amateur radio with the Internet worldwide to expedite emergency communications among disaster victims, family, and friends.

"The concept of E-COMM is simple," Hart said. "If you are in a city where disaster strikes, or if you are experiencing an individual emergency, E-COMM will pass a health and welfare message, anytime day or night, to your family and friends, wherever they reside, even if phones are down and power is out . . ."

Getting a message to E-COMM is accomplished in cooperation with ARES, the Amateur Radio Emergency Service. The new emergency center plans to form a strategic alliance with ARES operators and groups. Those operators and groups are expected to be listed in city directories and other databases.

The new communications center to be built in Lakewood, Colorado, will include HF, VHF, satellite, packet, an e-mail server, an ftp server, and a WWW server all connected to the Internet. For more information you can contact founder John Hart directly at *E-COMM, Inc., 767 South Xenon Court, Suite 117, Lakewood, CO 80228; (303) 987-3246, FAX (303) 987-3246, or Internet: jhart@teal.csn.net.*

Mighty Microwaves From Denmark

According to Steen OZ9ZI, it was a surprise to learn after the Danish Microwave Activity Week 1993 that what they thought was a world record on 145 GHz had been broken almost before it had been set. The aim was to set a new record in the course of the D. M. A. Week 1994 but the weather did not permit this. Therefore, a decision was made to attempt the new record as soon as the weather improved.

Organizers selected a distance of 11 km over Arreso, which had been previously used for the first 10 GHz tests back in 1983. A talk back frequency of 47 GHz was eventually agreed upon.

The SSB QSO was carried out on 02-07-94 at 16:30 GMT with a 5-6 / 5-7 report. Stability was surprisingly great—the frequency difference was only 146 kHz in relation to the estimated difference, and the frequency drift was acceptable.

The following equipment was used for this feat: DB6NT's 12 GHz injection chain and doubler/ampiifier (12/24 GHz) and a double-balanced harmonic mixer with four Russian-made diodes. Transmitter output was -7 and -9 dBm, the receiver noise figure 13 dB. The aerials are 25 cm Procom dishes with a back-fire feed system. According to OZ1UM's calculations, these stations should be able to transmit 60 kM! *TNX OZ9ZI.*

Thailand Celebrates Communications

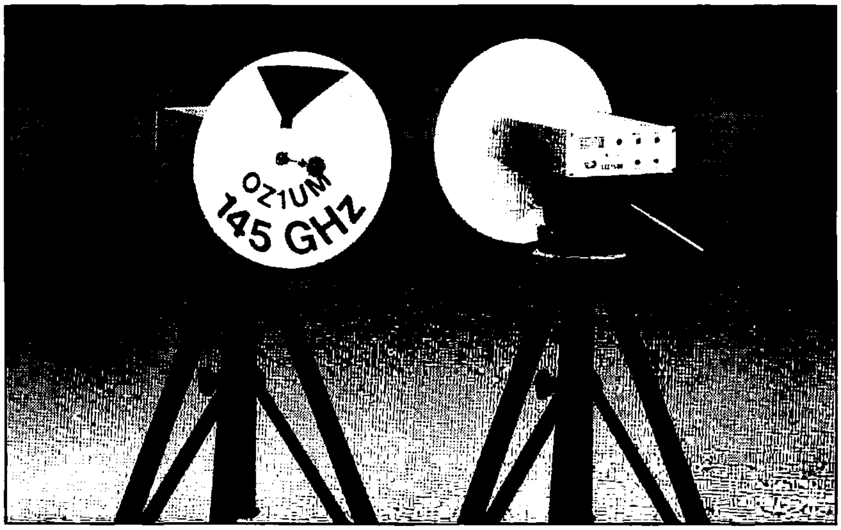
On 4 August, 1994, Thailand celebrated its National Communications Day. The theme of this year's celebration, "Communications for a better life of the Thai people," was celebrated by speeches, tributes, an exhibition, a two-day seminar—attended by both local and foreign participants—the issuance of commemorative stamps, first day cover and the distribution of commemorative books. *TNX Newsletter of the ITU.*

Japanese Amateurs Help Earthquake Victims

According to the ARRL as reported in the *Ham Arundel News,* more than 200 hams were key contributors to emergency communications in earthquake ravaged Kobe, Japan recently. On January 16, the major temblor shook Kobe's metropolitan area, killing more than five thousand and leaving tens of thousands homeless.

Amateurs and their radio stations have been instrumental in connecting relief centers and providing information on road conditions and traffic, health and welfare, and the availability of food and water. Hams have also been key in helping residents locate missing loved ones.

Some two hundred handhelds were provided in cooperation with the Japanese Amateur Radio League and the Japan Amateur Radio Equipment Industry, at the request of the Ministry of Posts and Telecommunications. In addition to the 430 and 1260 MHz HTs, three repeater stations were supplied by JAIA member companies for the rescue operation. *TNX ARRL; The Ham Arundel News, February, 1995.*



A look at the 145 GHz equipment used to set a new world distance record. (See text.)

A Practical Weather Satellite Receiving System, Part 2

Software and interfacing with the PC.

by Angus Anderson ZR6UM

Last month we covered the setting up of a weather satellite receiving and decoding system for polar orbiting satellites, the pictures from which can be displayed on a PC using a shareware package called JVFAX 6.0. Part 1 covered the antenna, preamp and receiver requirements, and the decoder unit.

This month we will cover the parallel I/O card to link the decoder to the PC, PC requirements, and the JVFAX 6.0 display software.

Weather Satellite Display Systems—A History

I remember seeing, in 1965, a hardware design from Fairchild for a 2400 Hz time-base divider. It used, can you believe it, gas discharge tubes to provide the numeric division to divide the 2400 Hz satellite signal to 0.5 Hz for synchronizing the early TIROS satellite signals. Have we ever come a long way since then!

Early display systems included direct exposure of scan lines from a CRT onto a camera, a line at a time. The camera shutter was held open for the duration of a satellite pass, where the variable intensity "flying spot" traversed a (preferably large) CRT side to side, top to bottom, thus integrating the picture onto film. The shutter was then closed, and the film developed to get a picture. Excellent results were possible with careful adjustment, but the system was slow, clumsy, and one could never see the picture in real time to make adjustments. Anyway, how many of us have access to darkroom equipment?

Later systems included fax-type printers that exposed photosensitive or electrosensitive film attached to a rotating drum, the speed of which was synchronized to the spacecraft horizontal line rate. The *optical* assembly was attached to a traveling horizontal lead screw, which traversed the paper incrementally, synchronized to the spacecraft vertical line rate. Using a modulated and focused light source, it would focus a dot onto photosensitive paper to produce the image. The other method used a current-driven stylus resting on electro-sensitive (conductive) paper, which burnt off the white outer coating, exposing the black undercoating, much like the way our current fax machines work. Varying the stylus current gave a good approximation of gray scale. An audio tape recorder was usually used to store received pictures for later playout, but archival picture quality was very dependent on tape quality and the way the audio tape recorder was maintained.

With the advent of microprocessor-based integrated circuitry, such pictures can be received and stored digitally, and permanently stored on hard disks or floppies, with absolutely no degradation of picture quality. Suddenly, the limiting factor on displayed quality is in the speed of the microprocessor (can it capture hi-res pictures fast enough?), the amount of digital storage available (for hi-res pictures you need lots of disk storage space), and not least, the video display system used.

Display Systems

One of the interesting things about digitally-based weather satellite displays has always been the trade-off between spatial resolution (the number of pixels per line able to be displayed on the screen) and the number of gray scales displayed. The two are directly related because multiplying one (the number of bytes per pixel) by the other (the number of pixels per line) gives the total storage requirements per picture (see below). Matjaz Vidmar YU3UMV states in his 1982 article in *VHF Communications* that he considers radiometric resolution (the number of gray scales displayed) to be far more important than the spatial resolution (the number of dots per line). In other words, if you have to make the choice in a trade-off, it is better to display more gray scales than more dots per line. I agree. In my experience, the absolute minimum number of gray scales for an acceptable picture quality is 16. Below this, you lose detail fast. I consider the absolute minimum number of pixels per line that can be displayed horizontally to be 256; again, below this you lose detail. Since the number of gray scales and the number of pixels have a direct relationship to memory storage required in a PC, usually some compromise has to be reached. For instance, 256 pixels per line at 4 bits (16 gray scales) will allow information for two pixels to be stored in a single 8-bit memory byte. In a 256-pixel line x 16 gray scale picture x 256-line picture, the number of bytes of memory storage needed is (256x256)/2, or only 32K of memory. If you consider the other end of the scale, a picture of 1024x800 pixels, a GOES picture at full resolution of 8 bits per pixel (256 gray scales), will need nearly 820K of memory per picture!

The original display system I built was the design from Matjaz Viroslav YU3UMV. This gave a 256-pixel x 256-line display, with 64 gray scales displayed on a black and white TV monitor. This hardware labor of love had about 60 TTL and DRAM chips on three PC boards, with 64K of dynamic memory and took a long time to debug and get working. Although picture quality was very acceptable, the system could only save to audio tape, and pictures could not be manipulated or printed at all after reception. In its day (11 years ago), it represented the state of the art. Systems that were affordable to the amateur stayed with the old technology until fairly recently, until PC hardware and software "came of age." I still use the YU3UMV system as a second display—and it works fine!

The PC Solution

Almost everyone has a personal computer of some sort at home. Many of these are based on the IBM PC. With the current price wars raging in the marketplace, prices of PCs have come plummeting down, and one can now buy systems that are excellent value for the money. For those of you who don't own a PC system, perhaps now is the time to invest!

With the correct programming, the PC offers flexibility in displaying, manipulating, printing, and saving pictures that hardware-based solutions just can't offer. Because the system is software-based, any upgrade is relatively cheap; you don't have to modify hardware, you just plug in another program or upgrade. The recent decrease in price of VGA display systems allows the display of 256 gray levels on a monochrome monitor. In these systems, 1024x768 display pixels is usual; this makes possible really sophisticated display systems at affordable prices. Such

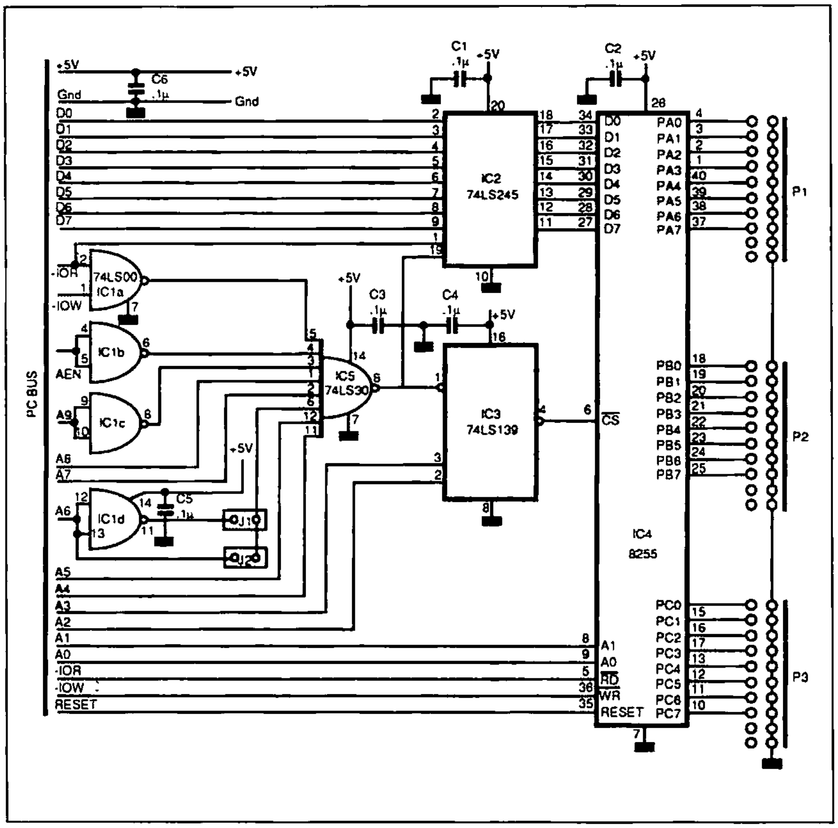


Figure 1. Circuit diagram of the parallel interface card.

systems can store satellite data at the theoretical maximum resolution possible. JVFAX 6.0 is capable of doing this.

Hardware Requirements for the JVFAX 6.0 Software

Minimum requirements are a PC XT or AT, with a minimum of 640K of memory, a hard disk drive of 20 Mb or more, and a 5-1/4" 1.2 Mb or 3-1/2" drive. A Hercules, CGA, EGA, or VGA display will work. I must say that results using other than EGA or VGA are marginal. If you have more than 640K of RAM, use the HIMEM.SYS utility so that JVFAX 6.0 will recognize the extra memory. This is useful for the movie option and the q(uick) save option (see below).

Preferred: A fast 286 (min 16 MHz clock), or a 386/486 with a minimum of 2 Mb RAM, VGA mono or color monitor. A VGA display controller with Trident, Tseng, Genoa, Paradise, Video 7, or VESA compatible chipset is preferred. All these controllers should be able to display SVGA 16 to 256 gray scale mode. For this mode, you should have at least 1 Mb of video memory on your display card. If you are rich or lucky enough to own one of the super super VGA controllers, you can store and display 1024 x 768 x 256 gray scales for superb results.

However, the standard VGA display mode of 640x480x16 gray scales (or colors) on a standard VGA card is very acceptable, as JVFAX 6.0 "dithers" the 16 gray levels to display an effective 64 gray levels on screen. Remember, what is stored in memory and what is displayed can be different. For instance, you might elect to store pictures at 800x800x256 gray scales, but you might only be able to display at 640x480x64 resolution. However, if you elect to magnify the picture, you will achieve far better results if you save at the higher resolutions.

A word about monitors: If you are upgrading to a VGA monitor, there are very cheap VGA black and white monitors available right now that offer superb value; they display 256 gray scales beautifully. In South Africa, the street price right now for a 14" B/W VGA monitor is under $100, a good value.

The PC Interface

The 8-bit parallel video signal from the decoder described in last month's article is fed to a plug-in parallel I/O card. This card contains an 8255 peripheral interface adapter chip, and a variety of common TTL chips that do the address decoding and data buffering. Figure 1 shows the circuit diagram of this parallel interface card. IC1 is a 74LS00 that, together with IC5, a 74LS30, decodes either address 1B0 (Hex) or 1F0 (hex), depending on where jumpers J1 and J2 are set. I usually use address 1B0. IC2, a 74LS245 buffers the data when writing to the PC data bus. IC3, a 74LS139, is an address selector. IC4 is an 8255 IC, which can be programmed so that any of 24 output lines can be set as an input or output. We will be using the PA0-PA7 lines as inputs. We have the advantage that the 8255 on power-up initializes its registers to bring up PA0 to PA7 as input lines, so the line direction control registers do not need to be set first. In other words, when you switch on, PA0-PA7 are ready to accept TTL inputs, perfect for our application. The two other ports can be used as control lines for other applications, if you are prepared to put a bit of programming into it.

The data and control registers of the 8255 are:

$1B0: Port 1a Read/Write buffer
$1B1: Port 1b Read/Write buffer
$1B2: Port 1c Read/Write buffer
$1B3: Port 1 Control register

We are only required to place data into port $1B0 from the decoder; the computer reads from address 1B0 whenever it needs to fetch a pixel value from 0 to 255. You can of course use ports $1B1 or $1B2 if you wish to. I happen to use port $1B1, or port 1b (PA1 to PA7). If you set the card to $1F0, then addresses run from $1F0 to $1F3.

If you wish to program the other ports, I strongly suggest that you get the programming data sheets on the 8255 from your friendly chip supplier. Setting bits on port $1B3 will program the three ports for input or output.

Building the Interface

This is pretty straightforward if you follow the component overlay in Figure 2(a). I strongly suggest that you follow the procedure of first checking for shorts on the power lines with an ohmmeter, plugging in the board, then checking for correct voltages on the power supply pins on all ICUs (+5V) at the sockets. Only then should you plug in your ICUs. The overlay plainly shows the orientation of the IC sockets and the ICUs—notches on the ICUs are plainly visible. Some ICUs have a dot at pin 1.

On this PCB overlay, only the traces on the component side are shown for clarity, since this is a double-sided board. If you elect to make your own PCB, remember to buy high profile sockets so that you can reach the socket pins on the component side, as you will have to solder all pads on both sides of the PCB. You will also have to stake through all feedthrough pads with off-cut wire. The kit PCB is plated through, so you will only have to solder one side.

Testing the Interface

Using GW BASIC, enter and run the following simple program. First select port PA0, PA1, or PA2 for testing when requested. We will use only port PA0 for our project. Use a voltmeter to check for 0V on each line when prompted, and for 5V on each line when prompted to enter the bit number. Measure on the appropriate 8255 IC pins by referring to the circuit diagram. Make sure that you use a sharp-pointed probe so that you do not bridge IC pins when measuring.

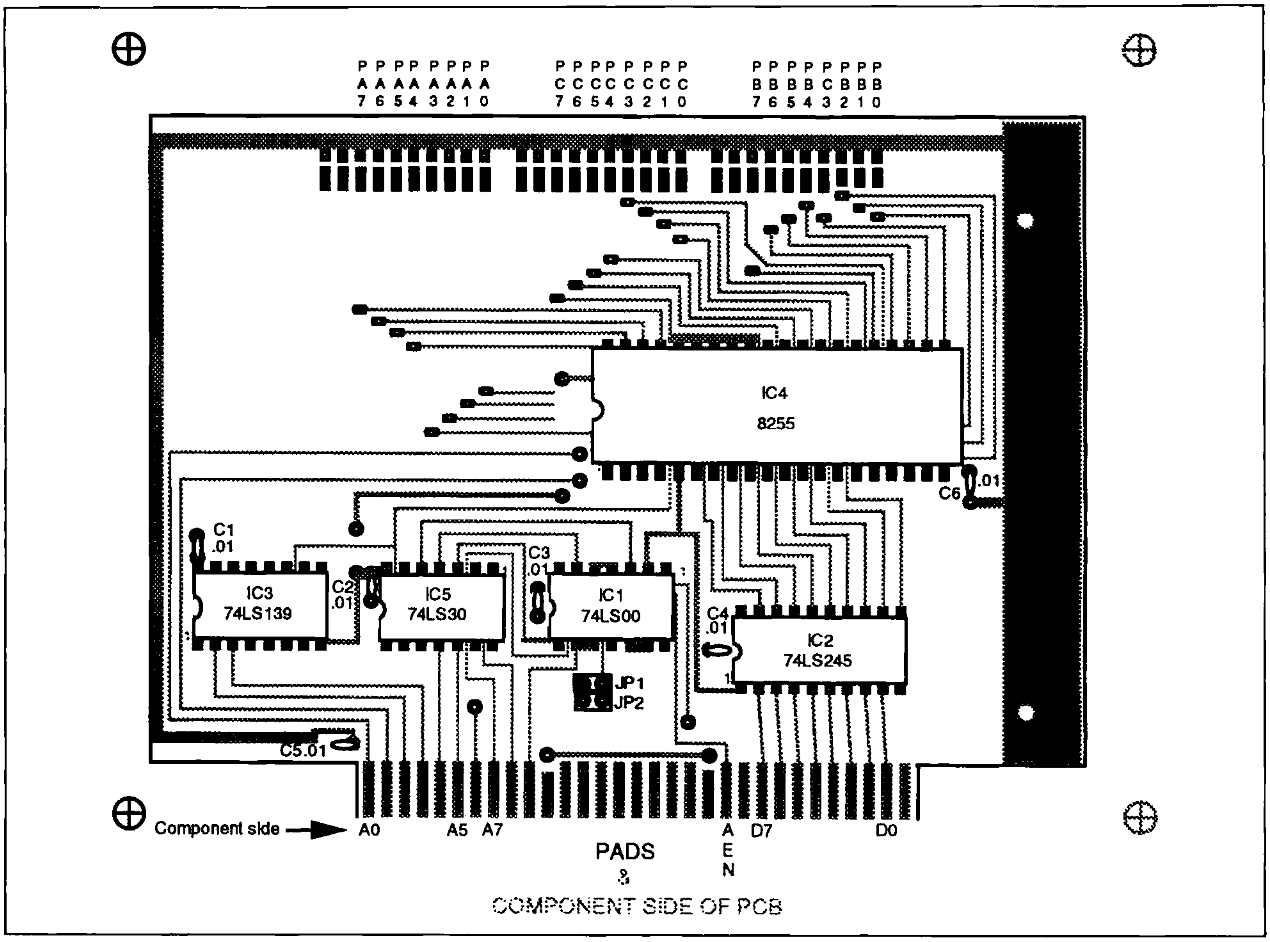


Figure 2. 1:1 PCB component overlay.

```
10 REM Test 8255 I/O lines
20 CLS
30 INPUT"Select 8255 port 0,1, or
2";PN
40 PRINT
50 PORT=&H1B0
60 OUT PORT+3,&H80:'SET PORTS 0,1,&2
AS OUTPUTS
70 OUT PORT+PN,0:'SET SELECTED PORT
LINES TO 0
80 PRINT" Physically check with a
voltmeter that all lines on port
";PN;" are 0V"
90 PRINT
100 INPUT " Hit enter when
done...";ANS$
110 CLS
130 INPUT "Enter bit number to set
high(0-7)";NUM
140 OUT PORT+PN,2^NUM:PRINT
150 PRINT"Now measure with a volt-
meter that bit (";NUM;") of port is
high"
160 INPUT " Hit enter when done,
<CTRL> <BREAK> to exit";ANS$
165 PRINT:GOTO 130
```

If all works as planned, your interface is complete. The only remaining thing is to strip and tin the free ends of the interface cable and solder the correct lines to the decoder board output pins. Remember to connect at least one earth line. I would strongly suggest that you provide some form of strain relief to the cable at the decoder using a cable tie.

Setting Levels on the Decoder

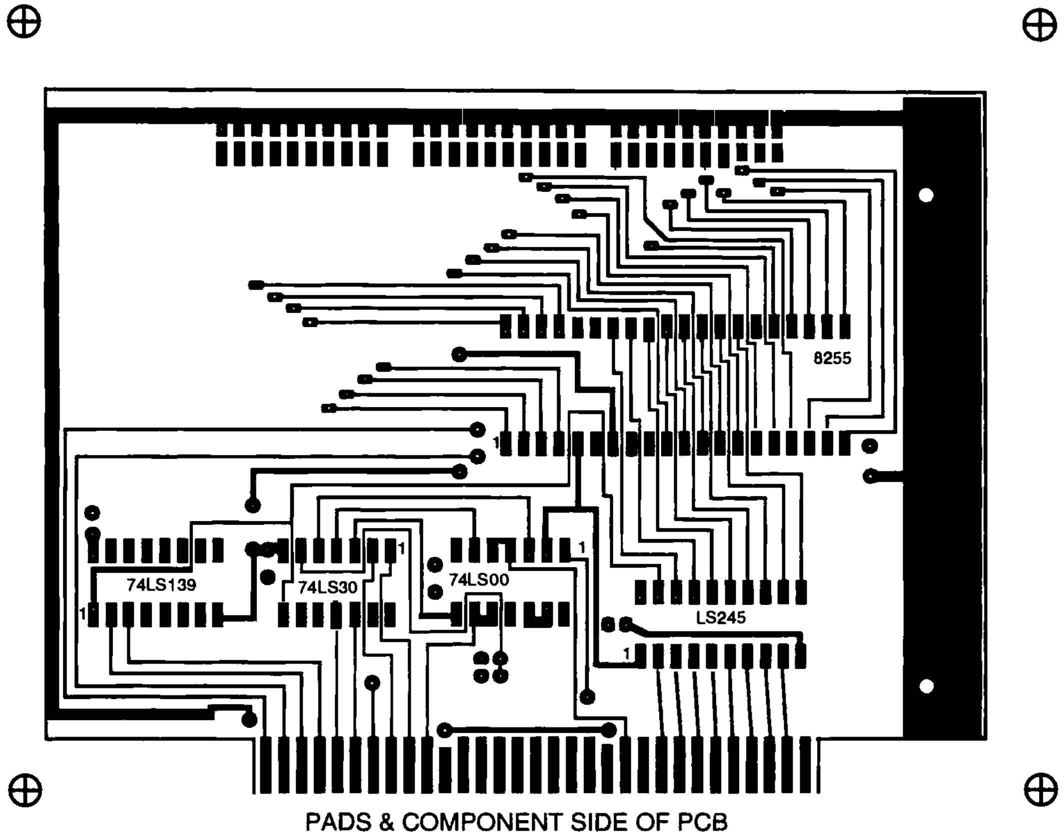
On a 2400 Hz input signal, you should initially adjust decoder VR2 (offset) voltage at IC5 pin 6 so that black turns to your first gray level on screen at about 0.3V DC. Peak white should be at around 5V. On a live satellite signal, set VR1 to two o'clock and adjust VR3 (coarse gain) so that you have comfortable travel for VR1. You can fine-tune these settings when receiving your first satellite signals using JVFAX 6.0, as JVFAX 6.0 has a very useful facility that will display your instantaneous picture brightness as a number from 0 to 255 in a window on screen.

Sometimes you will get a picture on screen that looks chaotic—the gray levels do not seem to be the right values. In this case, check that you have wired bits 0-7 from the output of the decoder to the input of the 8255 in the right sequence. Be careful—the decoder board bit output pins do *not* go in a bit-0-to-bit-7 sequence. Match the output bits of the decoder (they are shown on the PCB) to the correct PA0-PA7 bits on the interface cable.

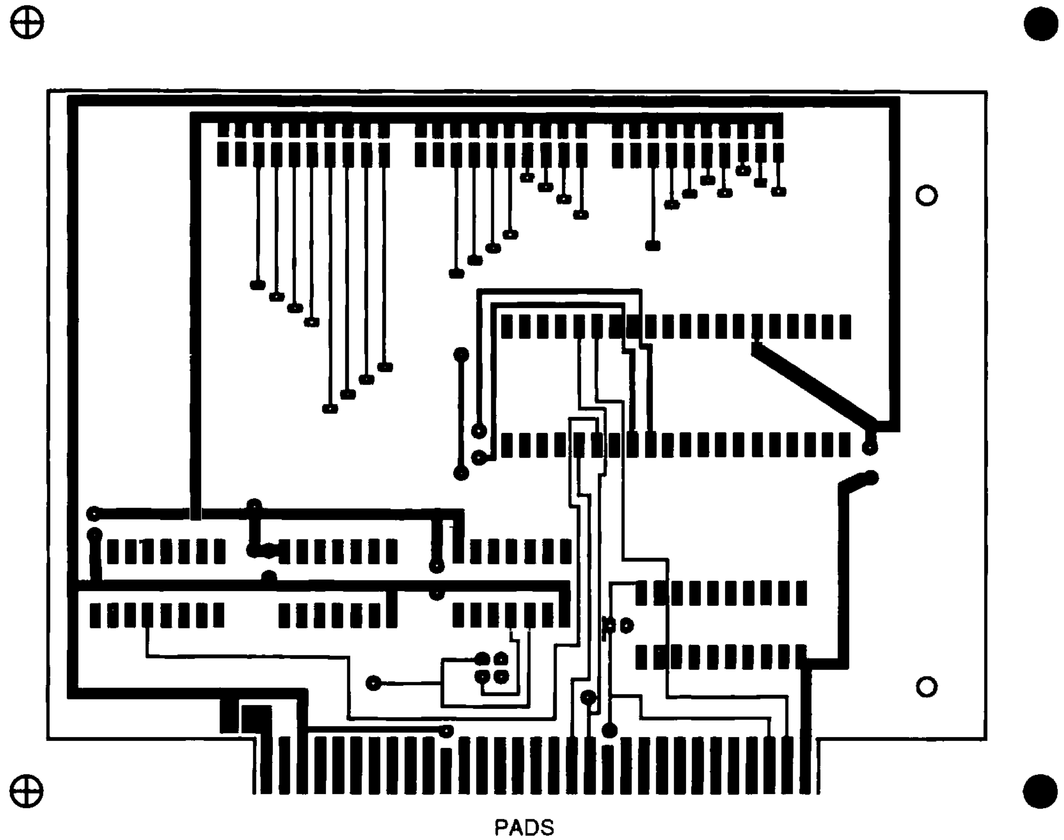
Figure 3 shows a Meteosat APT transmission, received using the decoder and display equipment described in this article. This is an example of the kind of quality achievable from Meteosat 4 APT. It was captured on PC using JVFAX 6.0 at 800x800x256 resolution, then transferred and played out via Apple Macintosh to a laser imagesetter with minimal processing. The GIF file was 650K in size. You cannot fail to recognize the Red Sea, but particularly interesting is the detail available showing the course of the Nile river, Lake Nasser, and the desert features inland. My 10-year-old son and I had a ball with an atlas identifying relief contours in the Saharan desert. What we proved was that what you see doesn't always exactly follow the picture in the atlas! This is what makes this hobby so rewarding! Note the JVFAX real-time status display on screen showing the instantaneous pixel values. In this illustration, they are centered around 30% gray.

Figure 4 shows the current station 1 operate. The receiver and PLL VFO are as offered in the ZS6BNT kit, available from me (see the address at the end of this article). The receiver is a sensitive dual-conversion design, with the second IF at 300 kHz, which is optimized for weather satellite reception. The low second IF frequency is chosen to optimize noise. The VFO output frequency is locked to the stable LFO.

The tone-operated squelch is used to open receiver audio on receipt of a 2400 Hz satel-



a)



b)

Figure 3a.) 1:1 PCB layout, component side; b) 1:1 PCB layout, solder side.

lite signal, which in turn triggers the start of a picture recording on the PC. This allows unattended recording on a casual basis. The S-meter is just an op amp in a bridge circuit for zero setting of the meter. The demodulator is the one described in the previous article. The preamp is a mast-mounted Hamtronics unit, and the antenna is the WB8DQT design.

The JVFAX 6.0 Shareware Fax Display Program

I first came across JVFAX 6.0 when browsing through the HAMNET libraries on CompuServe. It was described as a fax program. It is all that, and more. JVFAX 6.0 was written by Eberhard Backeshoff DK8JV, and all he asks is that those who download the program operate on the shareware honor system, where a donation is requested. Sending a donation will get you the latest version of the program on disk, as well as a variety of alternative hardware interface designs for interfacing your PC to your receiving system. I implemented the system using the home-built decoder unit described last month. DK8JV offers an innovative hardware and filter design for 255 gray scales using the control lines on a PC RS-232 port! The details are at the end of this article.

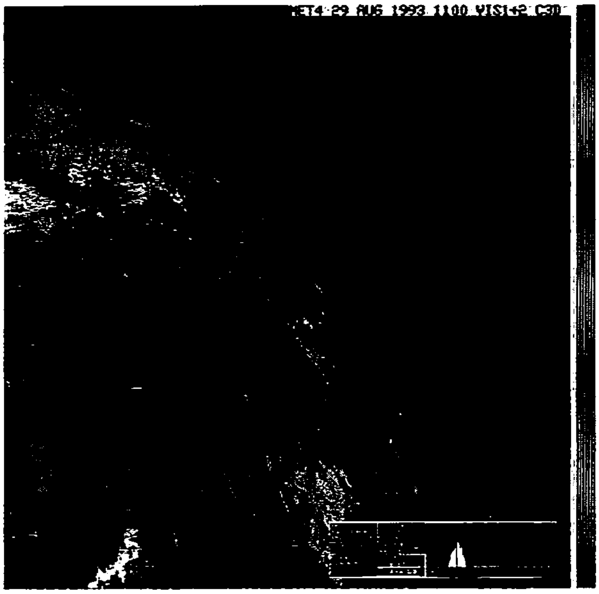


Figure 4. Meteosat APT transmission, received using the decoder and display equipment described in this article.

JVFAX 6.0 will decode and display just about any facsimile transmission, from FM-modulated weather chart transmissions on HF or SSTV to AM transmissions from weather satellites. It will do this at all accepted line rates and aspect ratios. A variety of interface schemes are catered for. Of course, weather chart transmissions use a tone that varies in frequency (FM) to encode white to black, so a different type of interface is required between the receiver and the PC. Weather satellites present a signal varying in amplitude, so are known as AM transmissions despite the confusing fact that they are carried on an FM transmission medium in the first place!

Pictures can be stored to hard disk in real time, with a computer of sufficient speed (286 or better). Yes, that is right: While the picture is being received, your computer stores the picture to hard disk! Early programs used memory storage only to store pixel values. Storing in real time to disk gets one around the constraint of limited memory in your PC.

A variety of display monitor types are catered for, including Hercules, CGA, EGA, and VGA. However, if you want good results, you should try to stick with VGA. Within the VGA environment many VGA modes are catered for, the most common of which is 640x480x16 gray scales. A variety of set-up screens allow direct setting of VGA video card registers to implement different modes, for those of you who like to experiment with such things. My most-used mode is SVGA 16-color (gray scales). JVFAX will actually dither the 16 gray scales so that 64 gray scales are actually represented on screen. Being lucky enough to have access to high resolution display equipment in my job, I have had fun implementing some of the VESA modes available, and have been able to display 1024x768x256 gray scales directly off Meteor, NOAA, and Meteosat transmissions, for spectacular displays.

Configuration

JVFAX 6.0 comes with a comprehensive English manual in the form of a disk file. When printed out, it gives you everything you need to know about the operation of this excellent package. We will not delve into the specifics of operational detail here, except to say that a number of things need to be set up before you can receive pictures. You need to set up your parallel interface address, the number of bits for the pixel, your monitor type, the printer, the default directory where pictures will be stored, and the satellite configuration which you will be receiving. This is all done on a configuration screen. Pictures are stored in CompuServe GIF format, which makes for easy interchange of data, as well as an efficient, compact picture storage format.

The video display modes catered for are CGA, Hercules, EGA-Hires, EGA 640x200, EGA 640x350, AT&T 640x400, VGA 640x480x16 colors, and SVGA 16 and 256 colors. A useful feature is being able to customize SVGA parameters by directly addressing the AH, AL, BH, and BL registers in your computer to set the video mode. For instance, I can set 640x480x16 SVGA mode 58 by setting the AL register to 58.

Mode Configuration

A database of satellite or fax type can be set up on a Mode configuration screen. This contains details of the lines per minute, the Index Of Co-operation (IOC is a rather academic way of stating the picture height-to-width ratio—I cannot believe the obtuse way academic types describe the simplest things!). Also required are the resolution in pixels per line, the number of intensity levels, and details of the satellite or fax transmission start and stop tones for automatic phasing, starting, and the stopping of any transmission. Each mode of transmission can be separately stored and called by name and changed on the fly when receiving pictures. Note that on some slower computer systems such as 8086 XT-based systems, the 120 LPM and 240 LPM line speeds only work when you choose lower screen resolutions.

Setting up Sync

One of the more important adjustments required is to set the line clock rate in JVFAX 6.0 to match exactly the spacecraft line clock rate. Otherwise, pictures will appear slanted on-screen, and if the timing is far enough off, the pictures will not be recognizable at all! As PC clock speeds vary widely, and the receive sync is controlled by the computer clock, you will have to make an initial set-and-forget adjustment to lock the spacecraft line rate to your computer. JVFAX 6.0 has a novel way of setting this. By pressing a key when viewing a picture, you get a vertical line which you can slant using the keyboard arrow keys so that it parallels the angle of slant of the sync line on the received picture. Hit "save," and that's all there is to it. You never have to set it again for the same spacecraft. It is stable too, because the sync is derived from the computer crystal-controlled clock. Other packages I have used required software timing loops to lock sync, which produced dreadful results because every time I reloaded the software, sync drifted.

Automatic and Manual Sync

On spacecraft that have start, sync, and stop tones, JVFAX can automatically place the sync line on the correct side of the picture. With the continuously transmitting NOAA satellites, sync pulses are very short and are difficult to decode, so you must manually move the picture sync bar to the left or right to display a whole picture. With GOES and Meteosat, phasing, picture start and stop are entirely automatic when the software is set up correctly.

Automatic Reception

JVFAX 6.0 can use time and date data in the PC clock to go into an unattended reception mode, and store the results to disk in a

Continued on page 18

A Practical Weather Satellite Receiving System

Continued from page 16

series of picture files. If you have set up the start and stop tones of JVFAX correctly, the software will recognize this, and close off picture file storage at the appropriate time. This is fine for GOES, Meteosat, and many fax transmissions which have clearly-defined start and stop tones, but not very useful if you are trying to receive continuous transmissions from the polar orbiters. In this case, reception starts at the satellite AOS time (as defined in JVFAX 6.0), and closes at the LOS time. You should set the AOS time a minute or two after the satellite rises above the horizon; this way you get the best picture quality and the smallest file size because you avoid the signal fades that occur right after satellite AOS when the bird is just above the horizon.

Because you can set an individual reception mode at any time, you can automatically switch modes after every picture received. JVFAX 6.0 also has the ability to execute a separate program just before it switches to automatic receive. In my case, this would usually be a program written in BASIC. It sets up receiver frequency via the parallel interface, using port PA1 on the 8255. You could also use the 8255 to switch receiver audio lines as well.

Fax Transmissions

The software will transmit displayed pictures in WEFAX 288, WEFAX 576, Ham 288a, and Ham 288b format. The easiest option is to take the modulated output off the PC speaker, in which case some low-pass filtering and signal attenuation will be needed to clean up the waveform before feeding to the TX input of your rig at the correct level.

Movie Option

You must have seen the animated weather pictures on your local TV station, which show cloud patterns moving across a stationary map. CNN does this, and the British Sky News has spectacular 3-D cloud views in their weather slots. JVFAX 6.0 will store multiple pictures of one GOES or Meteosat quadrant, which are only separated in time. The ground features appear to be standing still, but the clouds move! You will need access to your local GOES or METEOSAT transmission schedule. You then set up automatic reception times for the same quadrant (picture) based on the schedule. Fifteen seconds before due time, JVFAX 6.0 will switch to reception mode and await a satellite picture start tone, then store the results in a sequentially-numbered disk file. When displayed, these files are sequentially loaded into RAM on the fly (so the more memory you have, the better).

Receiving Pictures and Adjusting Your Decoder

From the main screen, selecting the FAX option will put you into reception mode, and the software awaits the first picture line. This builds up line-by-line from the bottom of the screen. When the line reaches the top of the screen, the whole picture scrolls downwards. Hitting the RCS key while receiving will bring up a window that shows a histogram of the white-to-black instantaneous picture values. This allows you to adjust the histogram so that most of the black-to-white energy is displayed in the middle of the X-axis on the graph, thus optimizing your black-to-white ratio. An option allows for display of the instantaneous 0-255 value of picture intensity as well. This is useful for setting up your interface. Simply feed a constant 2400 Hz tone to your decoder, adjust VR1 to 2 o'clock, and adjust offset pot VR3 for a value of 255—when the peak white LED just begins to light. No signal should give a value of 0.5 on the display. You can also adjust peak levels while receiving pictures, if you have GOES or Meteosat receiving capability. On these satellites there are lots of transmissions with 10 seconds or more of continuous peak white or full black. This allows adequate time for you to get that adjustment screwdriver in there. With NOAA transmissions this is a little more difficult, as white and black pictures are transmitted side by side, and so your peak white and peak black values do not stay there long enough to allow definite measurement. In this case, experiment for best results.

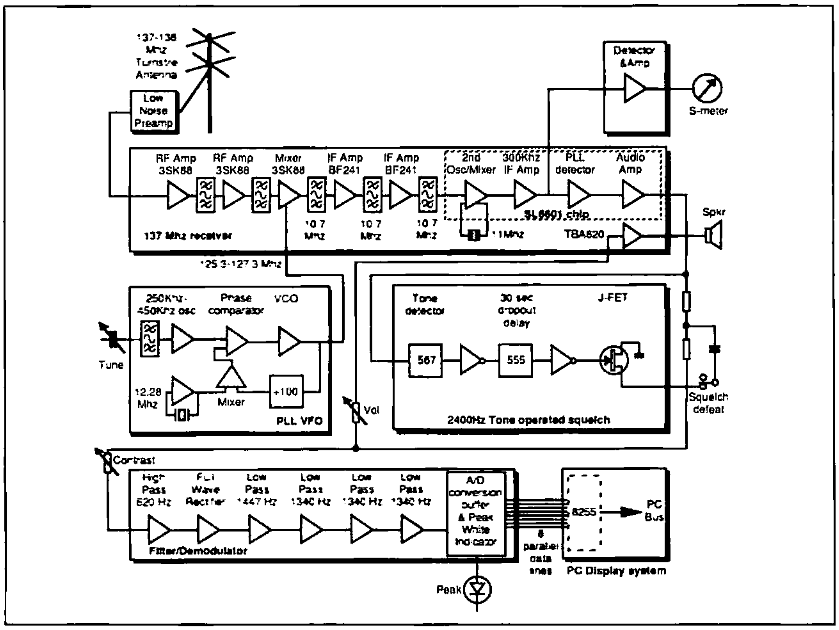


Figure 5. Station block diagram.

Zooming, Rotating, and Colorizing Pictures

In the view mode, you can recall and display any stored picture. All pictures received casually are stored in a temporary file called TMPPIC.GIF on disk, which can be renamed if required. Each succeeding picture overwrites the temporary file. In this way, you do not require limitless disk space and you can extract your best pictures by renaming them. A Q(U)ick save facility on screen will ask for a filename. In real time, you can only see part of the unfolding picture on screen but the whole picture is stored, and on a 15-minute NOAA pass this can occupy over 2.7 Mb of disk space! When in view mode, JVFAX 6.0 allows you to zoom into any part of a stored picture. You simply frame the area required to be enlarged by using keyboard keys and it zooms in to fill the whole screen. So, the smaller the frame, the bigger the magnification. Too much magnification will bring it to a point where the pixels become very "blocky"—they appear to be square. This is caused by the dithering technique used. You can zoom the picture 10 times, but a practical maximum is about four times; with greater magnification than this viewing results generally become unacceptable.

You can rotate or invert pictures. If you use the SVGA 255 color mode, you can colorize the picture with red, green, and blue in various intensities to create very natural-looking color displays, which seem to be optimized for a natural-looking picture—for instance, ocean colors could be blue, ground is brown or green, and clouds are white. A graphical sliding pointer allows for easy setting of color values.

Using a feature called JVcolour, a fairly natural false color image can be displayed while received, with seas deep blue, land blue or green, and clouds white.

How Do I Print My Pictures?

There are a number of printer formats set up for JVFAX 6.0, which work on printers connected to the PC's printer port(s). Most of these are dot matrix types, following various EPSON or IBM formats. I have never been able to get a decent-looking picture off a dot matrix printer, because they are incapable of printing gray scales directly and must emulate a gray scale by clever programming;

they print the dots further apart or closer to create the gray scale. Although I haven't used it, the HP Laserjet 500+ driver looks promising as laser printers can create limited gray scales but have 300 DPI resolution. I have used the CITOH 8510 driver and it prints fine within the capabilities of a 9-pin dot matrix printer. JVFAX allows you to balance printing intensity for various levels of gray on these printers, a useful feature that allows better-looking printouts.

Confessions of a Cheat

I have to confess that I cheat. Being in the computer graphics business, I transfer my stored GIF picture files over a local area network onto an Apple Macintosh, where I enhance them if needed, and then print the pictures to a PostScript laser printer, or directly to a Laser Imagesetter. All the pictures in this article were produced this way. One of the by-products of this route is that it is easy to produce mosaics of the whole earth by automatically capturing the nine Meteosat pictures required with JVFAX 6.0 and then joining them together as a single picture using a program called Adobe PhotoShop (see picture on page 3.) Registration between spacecraft transmissions is so good that I defy anybody to spot where the pictures join! However, as there is anything up to a three-hour gap between the first and last transmissions of the nine pictures in the Meteosat transmission schedule, winds can move the clouds during that time, causing some misregistration in cloud patterns between pictures.

Using the System

A typical satellite pass at my station would be captured thus: I prepare a series of simple GW BASIC programs, whose file name is the satellite name. This executes by outputting a simple binary number to separate output lines on port PA1 of the 8255 chip. Each program (for each satellite) contains a different PA1 output value. For instance, program NOAA11.BAS will make only line 1 of PA1 go high, NOAA12.BAS will make line 2 only go high, and so on. Since you can call any BASIC program when calling any satellite configuration on JVFAX 6.0, switching is easy. The output line, with some suitable buffers, is used to enable an oscillator crystal in the receiver via diode switching. By executing the appropriate program, one can change receiver frequency.

Using the InstantTrack satellite tracking program, I scan the best satellite passes of the day, noting the satellite name, acquisition time (AOS) and loss of signal (LOS) time. This information is fed to JVFAX 6.0. At 15 seconds before the appropriate time, JVFAX will select the appropriate satellite, and execute the BASIC program for the satellite being received. This adjusts receiver frequency and selects the specified satellite type (line rate, etc.). It will then go to receive mode, awaiting opening of the receiver squelch. At AOS squelch opens, starting picture recording. At LOS time, or on closing of receiver squelch, the computer file will close, and the software awaits the next programmed satellite AOS time.

Just be aware that you need a large hard disk capacity if you want to automate lots of passes during one session!

Where Do I Find the Satellites?

You have a PC. The easiest way to predict a satellite pass is to obtain one of the excellent satellite tracking programs to run on your PC. I like InstantTrack (available from AMSAT NA) because one of its options is a fantastic real-time world map display of the satellite pass. To update InstantTrack, you can load the latest Keplerian (orbital) elements in NASA format automatically into InstantTrack from files downloaded off CompuServe or other BBS systems. Other tracking programs abound. Look in the CompuServe "Amateur Satellites" library; there are a number there. Failing this, you can just tune your receiver to the correct frequency and wait for a signal. Because the NOAA satellites are in "Sun Synchronous" orbits, they will pass within range of a ground station anywhere on the earth's surface from two to four times a day, and at about the same time every day.

RF Interference

All PCs are "RF dirty." They emanate harmonics on all sorts of frequencies. Generally, at VHF this is not as much of a problem as HF, but when I first implemented my system I had a nasty harmonic almost slap on 137.5 MHz, one of my most-used frequencies.

By careful shielding of antenna and cables and earthing the computer box directly to a ground spike, I was able to get rid of most of the interfering carrier. I found that shielding the cable between the demodulator and the interface gave the most reduction in interference. Although you can buy ribbon cable with shielding on one side, the easiest fix is to cut a number of lengths of aluminum kitchen foil and wrap it around the cable. Experiment with the best point at which to earth the cable.

Conclusions

I have tried to give all the information and hints necessary to allow you to build up an affordable weather satellite receiving station. My results have been very rewarding, and I would like to hear from anyone who implements this project. Write to me at the postal address given below, or on CompuServe 70272,1602. JVFAX 6.0, being shareware, gives very good value for the money, in addition to unbelievably good displayed pictures.

If you want to learn more about receiving weather satellite pictures, I heartily recommend WB8DQT's publication *The Weather Satellite Handbook,* Fourth Edition (or maybe fifth by now), available from Uncle Wayne's Bookshelf. Ralph Taggart is a genius at explaining the arcane subject of satellites and weather to laymen. Expect plain, simple-to-understand language, and a comprehensive coverage of the subject, together with easy-to-understand constructional information.

Please support DK8JV in his programming efforts by giving a donation. In return, he will send you the latest version of JVFAX, as well as a lot of interface details, including a sophisticated FM fax decoder schematic for HF use, all on disk files.

Complete kits for the parallel interface board are available from me for $40, which includes international air parcel post and packing. For international customers, be aware that sometimes there might be customs duties to pay in your country.

JVFAX 6.0 is available for $10, which covers the cost of the disk and international airmail postage (or you can download the earlier version from CompuServe Hamnet): Angus Anderson, P.O. Box 41544, Craighall 2024, South Africa; Tel: (business hours) country code 27, city code 11, 807-1163; Fax: (business hours) country code 27, city code 11, 807-1167; CompuServe: 70262,1702. I accept Visa, MasterCard, cash, or international money orders. No checks, please. South Africa is two hours behind GMT, six hours behind EDT, and nine hours behind PDT.

You can contact Eberhard Backeshoff DK8JV, the author of JVFAX, at Obschwarzbach 40a, D-4020 Mettmann, Germany; Tel: (49) 2058/4864 (please—only between 18:00 and 19:00 CET) ZR6UM suggests a $25 donation. It's well worth the trouble. You get more back than you donate!

Parts List, Parallel Interface

C1,C2,C3,C4,C5,C6	0.01 µF
IC1	74LS00
IC2	74LS245
IC3	74LS139
IC4	6255PIO
IC5	74LS30

Miscellaneous:
Capacitors are disk ceramic, 16V or more.
PC board, double-sided with edge connectors (If not plated through, see comments).
1 x 20-pin DIL IC socket
2 x 14-pin DIL IC socket
1 x 16-pin DIL socket
1 x 40-pin DIL socket

(Note: Use high-prollle IC sockets with exposed top pins if not using plated-through PCB. This allows soldering to IC connections on both sides of the PC board.)
3 x 20-pin PCB mount box headers, male. I suggest that you buy a strip of 70x2 pin headers and cut to suit.
1 x 20-way ribbon cable, length to suit, with a 20-way crimped female box header on one end, free cable on the other. The free ends are soldered to decoder vero pins via an optional interface socket.
2 x 2-way jumper pins and jumpers. You can use offcuts of the 20-pin box headers if you buy the box header strips and cut the number of pins to suit. The jumpers can be obtained from almost any old PC PCB.

Build an Intelligent Relay

A quick-to-make microprocessor-based device, controlled by your HT.

by Bruce R. Knox N8LXS

If you want to check out a length of coax, remotely reset a cluster or BBS node, or test a doorbell installation, you often get someone's help. Wouldn't it be nice to have a device that could provide you with a contact closure, at your command, using your hand-held transceiver (HT)? This article will show you how to build such a device, which provides you with a set of functions that will make your life a whole lot easier in these situations.

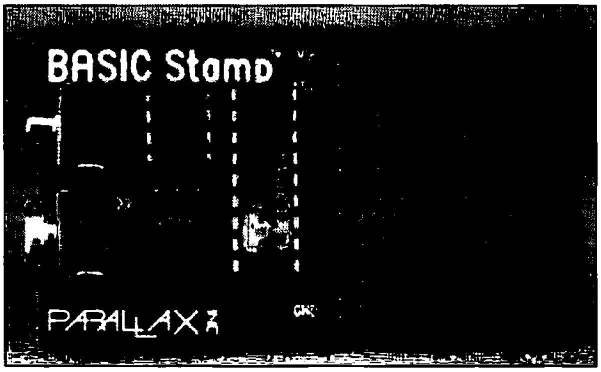


Photo A. The Parallax BASIC Stamp.

You Need a Microprocessor

In order to provide a set of useful functions, some form of intelligence would be required for this device. I looked over the range of microprocessors available and most seemed to be gross overkill for such a simple application. In most cases, even simple single-chip microprocessors like the Motorola 68HC705xx require a multi-hundred-dollar development environment and a lot of construction to gain even basic functionality.

Enter a nifty product from Parallax, Inc., called The BASIC Stamp. This is a simple-to-use but highly functional microprocessor that fits this (and many other) applications perfectly.

What is The BASIC Stamp?

The BASIC Stamp is a PIC microprocessor mounted on a small printed circuit board (2.5" x 1.5", or 6.3cm x 3.8cm). It sports a 5-volt regulator, reset circuit, resonator, input/output (i/o) header for the eight i/o lines, and a 10 x 14 wirewrap/prototyping area. The folks at Parallax have developed code for the PIC microprocessor that interprets "tokens" generated by a BASIC language tokenizer that runs on a standard PC. This enables you to develop applications in a high-level language, download to The Stamp, and run. It runs your instructions at about 2,000 per second (50 microseconds per instruction, typically), and the supplied EEPROM (Electrically Erasable Programmable Read Only Memory) can hold about 80-100 BASIC instructions per program.


Photo B. The finished Intelligent Relay.

Figure 1 shows a brief summary of some of the more interesting Stamp BASIC commands. While the program speed/size limitations of this device will most likely prevent you from doing many digital signal processing applications on it, there are many others you will be able to do, and in a fraction of the time it might take you with a more conventional microprocessor environment. The best part is that the development environment that runs on your PC costs only $99 from Parallax, Inc., and you can use it over and over again. Stamps cost $39 in unit quantities, and discounts start at five units.

The "Intelligent Relay"

With this handy building block in hand, it was pretty easy to develop the application. Figure 2 shows the schematic for this application. It was built entirely on the prototype area of The Stamp using point-to-point construction techniques. The

basic hardware requirements for this device are:

1. Function from 12 VDC (The Stamp comes this way); 2. Provide a normally open and closed relay output; 3. Provide a DTMF tone decoder to receive commands; 4. Provide a means of transmitting tones from the HT If you are using a remote switch to check out an installation—it is really nice to know if, in the case of an unexpected result, your remote switch is working. To accomplish this, I made a connection to the microphone input of the HT. Through this connection, each command can be acknowledged by transmitting a Morse code "R." In addition, an "O" (a shortened version of "0") can be sent for off, an "A" (a shortened version of a "1") for on, and a callsign for identification purposes. The interface to the HT was implemented using capacitor C2 for the audio tone, and resistor R1 for keying the HT. You may find that you have to adjust the value of R1 or C2 depending on the HT you use. If the HT you choose does not support this hardware arrangement (keying and audio on the same wire), you can easily adapt it to support a relay for the keying and keep the tone generation output separate. Tone generation is handled by a command called "SOUND" in The Stamp's BASIC interpreter, and keying of the HT is handled by a simple logic level command (see the software listing).

Receiving DTMF (Dual-Tone Multi-Frequency) tones is pretty easy these days. A Teltone M-8870 DTMF receiver was chosen for this purpose. The M-8870 (U2) uses a minimum of external parts and runs off a single 5-volt DC supply. The outputs of the M-8870 consist of four data bits that tell you which tone was most recently decoded, and a strobe line that goes to 5 volts when a tone is present. These five lines are run to five of the eight lines on The Stamp. The M-8870 requires a cheap 3.58 MHz crystal (sometimes called a colorburst crystal), three resistors and two capacitors to get it running. In this application, none of the values (except the crystal value) are critical, with a 20% variance being acceptable.

The output from the device is a relay, designated as K1. This is a 12 volt DC relay that is powered from the external supply (before the on-board 5-volt regulator). Resistor R2 limits the base current to transistor Q1, and standard NPN, such as a 2N2222 or 2N3904. When saturated, Q1 energizes K1. Diode D2 is provided to snub the turn-off spikes generated by K1.

Diode D1 was provided for two reasons. The first and most important reason is to protect the device from a potential reverse polarity connection. The other reason is to introduce a volt or two of drop to limit power dissipation in The Stamp's regulator. Capacitor C1, a 0.01 disc, is provided to help keep RF out of the device.

As mentioned above, point-to-point construction techniques were used for this device. Photo B shows the finished unit is a small aluminum enclosure. Small, solid, insulated wire can be used, and the circuit can be built in about two hours. One word of caution: The column of holes in the prototyping area right next to the header are connected to the header! Use these holes to pick up your signal connections to the other parts of your circuit. Finally, a spare coiled cable was available for the device-to-HT connection. If you don't have one of these available, shielded cable and separate connectors will work just fine. The block diagram in Figure 3 shows you how the system is used.

```
Program Control

IF... THEN
GOTO
GOSUB
FOR... NEXT

Numbers

Integer math: +, -, *, /, etc.
Logicals: AND, OR, XOR, etc.

Digital I/O

LOW         set pin low
HIGH        set pin high
TOGGLE      change state of pin
PULSIN      measure pulse width
BUTTON      do button functions

Serial I/O

SERIN       Async serial input
SEROUT      Async serial output

Analog I/O

PWM         Generate PWM output
POT         Measure value of a potentiometer

Sound

SOUND       Generate tones/white noise on a pin

There are more commands.
```

Figure 1. Some of The Stamp's commands. (See Figure 4 for others.)

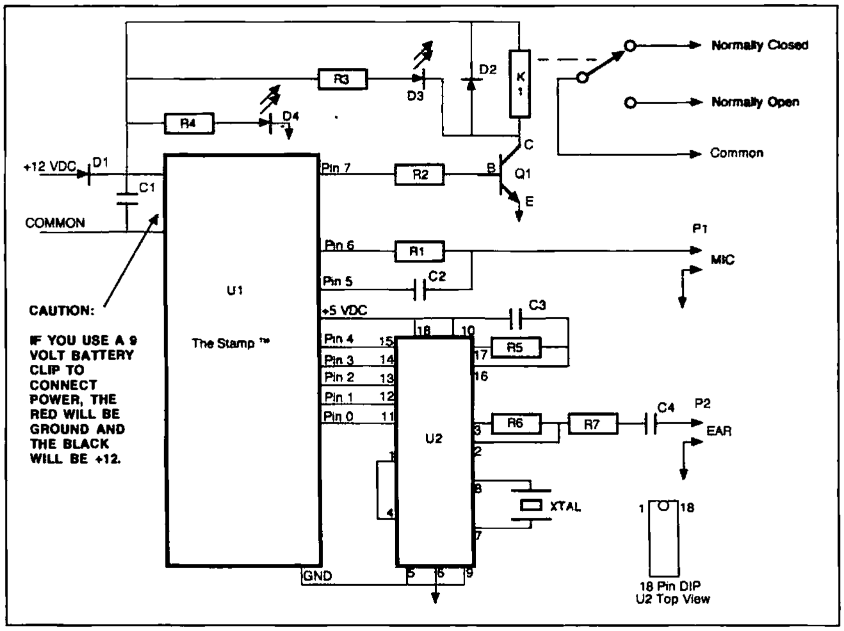


Figure 2. The Intelligent Relay Schematic.

The Software

Figure 4 shows the complete listing of the Intelligent Relay Program. The only reason

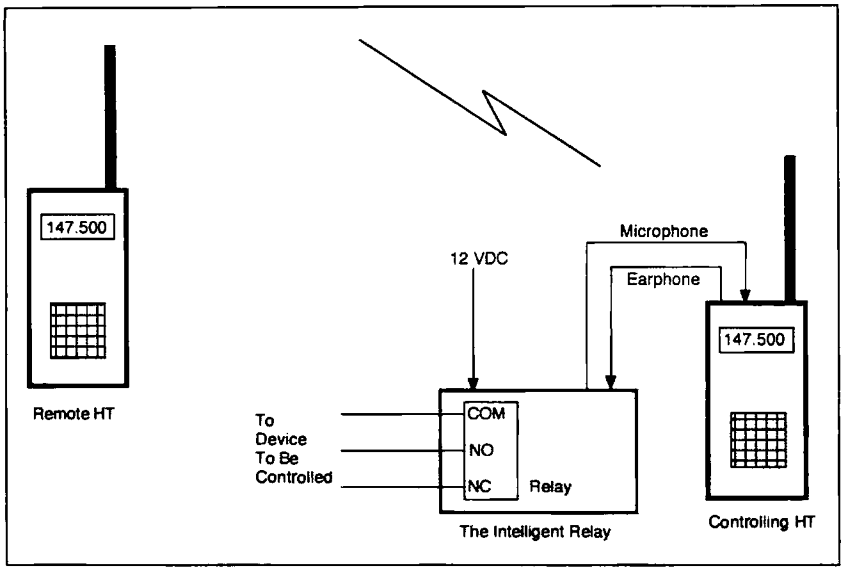


Figure 3. Block diagram of the Intelligent Relay.

the program looks so long is that it is heavily commented. The application performs the following functions:

DTMF 1: Turn relay on for 2 seconds, send "R"
DTMF 2: Pulse relay for x times (digit after 2), send "R"
DTMF 3: Turn relay on, send "R"
DTMF 4: Turn relay off, send "R"
DTMF 5: Toggle relay, send its new state
DTMF *: Send current relay state
DTMF #: Send ID (N8LXS in this case)

The most important feature of the software aspect of this project is the ease with which it can be implemented. You simply connect a three-wire cable from an LPT: Port on your computer to a header on The Stamp, run The Stamp program, enter your program into a text editor (included), type ALT-R when you want to run, and your program will be off and running. Bugs? Well, there's a DEBUG instruction that enables you to print variable values back to the PC to see what might be wrong. With the possible exception of making a pin into an output when it is connected to an external output, it's just about impossible to break The Stamp with software. So go have some fun!

Using the Intelligent Relay

You'll find many ways to use this device in addition to those mentioned earlier. Radio Shack HTX-202s were used to develop the design in this article. A Yaesu FT-470 was used as the remote radio, and this worked fine. However, when the FT-470 was connected as the Intelligent Relay radio, some problems with the radio keying were encountered. You can fix problems like this by playing with the values of R1 and C2. Also noted, a Kenwood TM-732 has a feature that phone patch users enjoy (I presume), but causes a problem here. The TM-732 does not release the PTT for about two seconds after the last DTMF digit is entered. This allows phone patch users to release their PTT while entering strings of digits. Even though the Intelligent Relay carries out its commands, the TM-732 interferes with the acknowledgement transmissions. You could fix this by changing the key-up delay in the program (or by not using the TM-732).

What Else Could You Do With This Design?

There are lots of things that could be done with this application. For example, you could monitor inputs and report them on command. Or you could transmit a call-sign with the relay (could be handy for remote on-air testing). But it is possible to run out of program space. So, depending on your application, you'll either have to get real clever in optimizing your code or you'll have to limit your functionality. The former is my preferred method, even though that method can drive you nuts!

Conclusion

In addition to DTMF-controlled devices, The Stamp lends itself to many other applications. You could make a custom keyer, a rotor controller, an antenna switch, or many other simple controllers. And since the device is software-driven, you can now dazzle your friends with fancy features that couldn't be done before without a large bag of TTL or CMOS chips and a lot of time and aggravation. Have a good time working with this powerful, yet simple, device.

Parts List

R1	2.2k 1/4W	
R2,R3,R4	1.0k 1/4W	
R5	300k 1/4W	
R6,R7	100k 1/4W	
C1	0.01 25W VDC disc	
C2,C3,C4	0.1 25W VDC	
D1,D2	1N4001	
D3	Yellow LED	
D4	Green LED	
K1	Relay	Radio Shack #275-249-A
P1	Mike connector	Radio Shack #274-290
P2	1/8" connector	
Q1	2N2222 NPN transistor	
XTAL	3.579545 MHz crystal	
U1	The BASIC Stamp (Parallax)	
U2	Teltone M-8870 DTMF decoder	
Box	4" x 2-1/8" x 1-5/8"	Radio Shack #270-239
Hardware	4-40 screws/spacers/nuts for mounting The Stamp	
Grommet	3/8" grommet for cable entry	
Wire	Shielded cable/relay/power leads as required	

Parts Availability

A set of components, including The Stamp and a 3.5" disk with the source code on it, is available from RF Applications, Inc. for $95. We can program your Stamp for an additional $20 (please give us your call). Please order this kit by mail or fax, VISA/MC accepted (encouraged), at 9310 Little Mountain Road, Kirtland Hills OH 44060-7951; Fax (216) 974-9506.

Note: Unless you order The Stamp programmed from us, The Stamp RF Applications, Inc. supplies is unprogrammed. You'll need the Development Environment described in this article to load the software. The BASIC Stamp Development Environment is available from Parallax, Inc. 3805 Atherton Road, #102 Rocklin, CA 95765. Their telephone number is (916) 624-8333. The Stamp is a trademark of Parallax, Inc.

```
Rem BASIC STAMP Control Program
Rem Intelligent Relay
Rem By Bruce R. Knox
Rem RF Applications, Inc.
Rem August 28, 1994

Rem You may copy this code, but please acknowledge its origin.

Rem There is a DTMF decoder on 0-3, strobe (active high) is on 4.
Rem Pin 5 is used for transmit tone
Rem Pin 6 is the PTT for the radio
Rem Pin 7 is the relay output (active high)

Rem Commands:
Rem  1  = Pulse on for 1 second
Rem  2X = Toggle X times
Rem  3  = Turn on the relay
Rem  4  = Turn off the relay
Rem  5  = Toggle the relay then Function 11
Rem  11 = Report relay status (A=on, O=off)
Rem  12 = ID (N8LXS in this case)

Rem Set up Pin Direction Registers (5 ins and 3 outs)

Rem Pin 7 = Output: Relay,      1=ON
Rem Pin 6 = Output: Key Radio,      0=Keyed
Rem Pin 5 = Output: CW Tone Out
Rem Pin 4 = Input:  DTMF Tone Present, 1=Tone Present
Rem Pin 3 = Input:  DTMF Bit 3
Rem Pin 2 = Input:  DTMF Bit 2
Rem Pin 1 = Input:  DTMF Bit 1
Rem Pin 0 = Input:  DTMF Bit 0

dirs = %11100000

Rem relay off (there's an NPN transistor there, 1=on)

low 7

Rem A low on Pin 6 keys up the radio, so start unkeyed

high 6

Rem Wait for HIGH (1) on DTMF Data Present Line

loop0:
     if pin4 = 0 then loop0

Rem Mask off unwanted top four bits

     b2 = pins & 15


Rem Sort out command

     if b2 = 1 then func1

     if b2 = 2 then func2

     if b2 = 3 then func3

     if b2 = 4 then func4

     if b2 = 11 then func11

     if b2 = 5 then func5

     if b2 = 12 then func12

     loop1:
     if pin4 = 1 then loop1

     goto loop0

Rem Pulse relay on then off

func1:

     high 7
     pause 2000
     low 7
     goto wait_gone

Rem Pulse relay x times (x follows the 2)

func2:

     func2_loop:
          if pin4 = 1 then func2_loop

     func2_loop1:
          if pin4 = 0 then func2_loop1

     b3 = pins & 15
     b3 = b3 * 2

     for b4 = 1 to b3
     toggle 7
     pause 100
     next b4

     low 7

     goto wait_gone

Rem Turn on relay

func3:
     high 7
     goto wait_gone

Rem Turn off relay

func4:
     low 7
     goto wait_gone

Rem Toggle relay

func5:
     toggle 7

Rem Fall right into func11 to tell the state of the relay


Rem Use "O" for off, "A" for on (shortend Morse 1)

func11:
     if pin4 = 1 then func11

     if pin7 = 1 then func110
     pause 200
     low 6
     pause 400
     gosub dash
     gosub dash
     gosub dash
     pause 200
     high 6
     goto loop0

func110:
     gosub key_down
     gosub dit
     gosub dash
     pause 200
     high 6
     goto loop0

Rem Send call (N8LXS in this case)
Rem 1=dash, 2=dit, 3=intercharacter space

func12:
     gosub key_down
     for b2 = 0 to 21
     lookup b2,(1,2,3,1,1,1,2,2,3,2,1,2,2,3,1,2,2,1,3,2,2,2),b3
     gosub send
     next b2
     pause 200
     high 6
     goto loop0

Rem wait for DTF tone to go away before proceeding

wait_gone:

     if pin4 = 1 then wait_gone

     gosub key_down

     gosub dit
     gosub dash
     gosub dit
     pause 200

     high 6

     goto loop0

Rem Morse code/radio support routines

dit:
     sound 5,(100,5)
     pause 15
     return

dash:
     sound 5,(100,15)
     pause 15
     return

send:
     if b3 = 1 then dash

     if b3 = 2 then dit

     if b3 = 3 then send_delay

     return

send_delay:

     pause 80
     return

key_down:
     pause 200
     low 6
     pause 400
     return
```

Figure 4. The software. Nothing to it!

73 Review

Number 6 on your Feedback card

by Breckinridge S. Smith K4CHE

Yaesu USA
17210 Edwards Road
Cerritos CA 90703
Telephone: (310) 404-2700
Price Class: $400

The Yaesu FT-2500M

A rugged mil-spec radio.

Ah yes, there's nothing like unpacking a new piece of equipment—makes you wonder how they cram it all in the box. If you want an interesting exercise sometime, try repacking the radio and the accessories back in the box in the exact same manner that it was originally packed. You can't do it; it takes special training.

The FT-2500M's size in inches, which is not given in any of the ads, is 7.75 by 6.3 by 2.0. The measurements include the length of the knobs which, incidently, are covered with that magic rubber that gives what I call a "tactile feel."

Appearance and Construction

The radio looks neat and rugged, and projects a functional appearance. Square, no fancy curves. All the gee-whiz buttons that you occasionally use are hidden away under the secret access door located on the right side of the front panel under the tuning knob. The top and bottom covers on the chassis are made of tight-fitting, rugged ABS plastic. I would have preferred metal covers for better shielding, but later testing in a strong RF field resulted In no problems.

The power leads for the radio have a fuse holder in both sides of the line, which is a definite plus. The fuse holders are rugged and totally "grab" the fuse, not just touch the ends of it. The SO-239 antenna connector is mounted in a recessed area of the heat-sink portion of the large one-piece diecast chassis. The connector has real threads that match your connectors. I tried several makes of PL-259 connectors and they all screwed onto the radio without any problems. The recessed area of the heat sink provides some protection for the SO-239 antenna connector.

Bench Testing

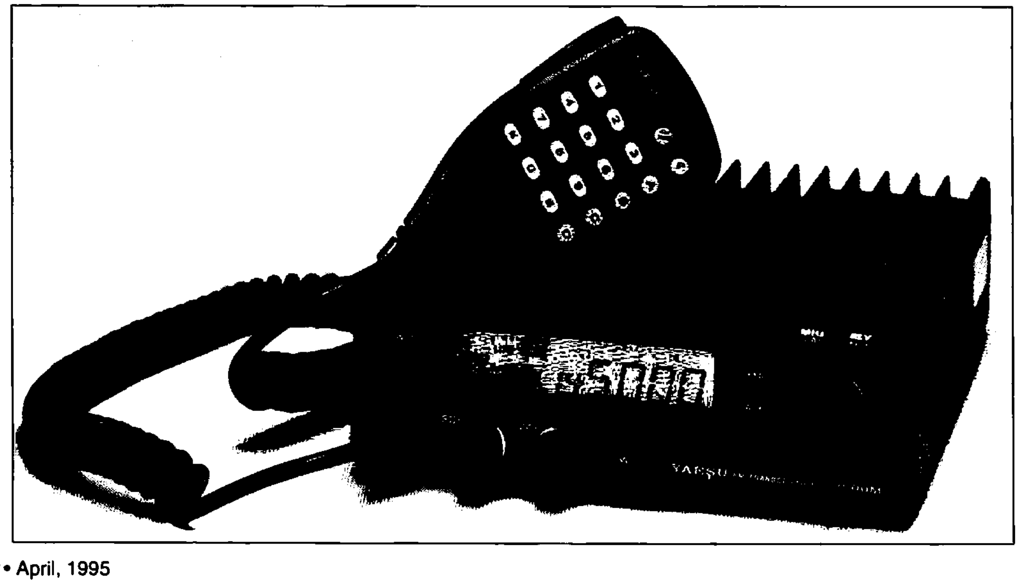
I fired the radio up and quickly checked the power and receiver specs. At 13.8 volts I measured 52 watts and found the power to be the same at both ends of the band. The power levels are selectable and can be programmed for each channel. The operators' manual gives instructions on how to open up the unit and set pots for the different selectable power levels. Mounting a quarter-wave ground plane antenna a foot away and standing behind a shield, I made several short transmissions with 50 watts. The unit operated in this unusually strong RF field with no problems. The automatic transmit power control was tested into several resistive loads representing SWR values starting with 3 to 1. Each test resulted in progressive lowering of the power. The final test consisted of just putting an emergency 19-inch wire in the rear connector and testing on the local repeater. Plenty of RF was available and the radio did not shut down. I don't recommend using just a 19-inch wire as a normal operation due to the radiation hazard and the poor load for the radio, but in an emergency it will work on the FT-2500M.

The transmitter has a "time-out timer" which can be programmed for five to 60 minutes. First thing I did was put in a five-minute limit. The timer resets each time you press the push-to-talk button and gives a little "beep" when the timer expires to remind you that you may be sitting on the mike button. I tested the timer on five minutes with 50 watts and, as expected, the heat sink got pretty warm but the power remained steady. There is also an automatic power-off timer, "APO," which will put the radio to sleep if you forget to turn it off. Since Yaesu recommends "direct" connection to your battery, this is a nice feature.

The radio looked clean on the service monitor and demonstrated a nice IDC (instantaneous deviation control) circuit which prevented me from over-deviating no matter how hard I yelled Into the mike. Third harmonics in the 440 MHz band were well below 60 dB suppression.

Bench-checking the receiver sensitivity was better than the specs of 0.2 µV for 12 dB SINAD. Now for the first acid test of the system. I programmed the receiver to scan from 144 to 148 at 5 kHz increments to see if there were any internal "birdies;" *none* were found with or without an antenna. The image rejection specifications call for better than 70 dB. During the mobile testing I drove through two of our local "RF alleys" to check for desense and overload. The receiver reacted very well and responded with just a little noise from a local high-power paging unit with the squelch wide open. However, it was not enough to break a normal squelch setting. Checks for desense with an adjacent mobile working on the same repeater were excellent. One of our club members tried running 25 watts in close proximity but still did not cause any desense problems.

Yaesu appears to have built a pretty bullet-proof receiver using their "Advanced Track Tuning (ATT)." Quoting from the receiver sec-



tion of their technical supplement manual, "after passing the antenna switching network signals (received) within the frequency range of the transceiver are then passed through a varactor-tuned bandpass filter before RF amplification. The amplified RF is then bandpass-filtered again by varactor-tuned resonators to ensure pure in-band input to the 1st mixer."

Military Specifications

One of the reasons I purchased the radio was the "mil-spec" advertisement. I contacted Mr. Chip Margelli K7JA, the Customer Service Manager at Yaesu, and he sent me a copy of the testing procedure using MIL-STD-810C, the vibration test accomplished by United States Testing Company Inc. in February, 1994. A portion of the testing included mounting the radio to a test fixture. Then the fixture was "bolted to the shaker." The transceiver was then vibrated for three hours along several different axes at different frequency ranges varying from 5 Hz to 500 Hz.

After this was over they conducted the shock test series! Quoting from the United States Testing Company report, "The transceiver was activated and subjected to three shocks in each of the plus and minus directions of each axis, for a total of six shocks on each axis. The pulses consisted of a sawtooth waveform with a peak amplitude of 40 "G"s over a duration of 11 milliseconds." The United States Testing Company reported that the transceiver was "fully operational at the conclusion of the vibrations test" and "there were no physical anomalies noted."

"The instructions received from Yaesu were clear and easy to follow and contained all the necessary cautions about out-of-band operations."

Bells and Whistles and Other Features

The microphone uses a now-industry-standard telephone eight-wire modular plug. These rugged connectors can be purchased at any telephone supply store and are easy to crimp on. You can now put on a mike connector in 30 seconds instead of spending 30 minutes trying to solder those elusive little tiny wires. The microphone looks complicated and busy, but feels light to the touch. The mike has a "lock" switch on the rear which, when activated, locks up all the buttons except for the touch-tones. I spent quite a bit of time on the bench trying to get the radio to scan and then finally found the lock switch. But get this: *The mike glows in the dark!* Actually, just the buttons glow, but this lighting feature will help make those midnight autopatch calls a little easier. If you don't like your mike to glow in the dark there is a switch to turn the light off. Yaesu supplies the MH-27 mike with the radio but you can purchase the simpler MH-26 without the touch-tone pad.

There are 31 memory channels. Now, I know some of you will scoff and insist that you need at least 100 channels, but for me 31 was fine. All I wanted was a tough simple radio. You can program a "name" for each channel (for example, CLUB, MARS, etc.). The names may be up to four characters long. There are provisions for the usual channel scanning or programmed limit scanning, but there are no provisions for storage of telephone numbers. As is standard in a lot of commercial equipment, this radio can clone (program) another radio with its stored information via the optional cloning cable. Once nice feature is that in the event you decide to start over with the memory channels there are provisions for accomplishing a general memory reset to clear all information.

The radio is equipped with CTCSS encode but you have to purchase the decode module and install it. I purchased the CTCSS FTSK-17A and installed it myself. I followed the instructions supplied with the FTSK-17A but found that the mounting location for the module did not match my radio. Now what? If all else fails go to the operating manual, and indeed the correct picture and instructions were in the manual. I did not review the DTMF paging system as our local repeater will not pass DTMF codes, which is quite common in some repeater controller configurations. I have to mention the "Ringer Melody Settings" which can be utilized during DTMF paging. We have finally gotten to the peak of the "bells and whistles" phenomena. If you are into serious bells and whistles you may program a user-ringer melody using up to 16 digits which correspond to notes from the traditional music scale! If you are bored while driving down the highway you can play back the melody with a test sequence. Personally, I prefer the straight ringing sound which sounds just like a phone.

Not only is the microphone lit but you can also adjust the radio panel backlighting on the LCD display to a manual setting or let the photosensor adjust the brilliance of the LCD display. The large LCD display is very easy to read. Night is the best display, with a yellowish background which can be controlled by the photosensor. In very bright direct sunlight the LCD panel changes to a black-on-gray high-contrast display.

Modifications

It's time to get the soldering iron out.

Packet modifications: The unit is not, I repeat, not 9600-baud packet-ready. However, there are simple instructions with pictures in the operating manual. Basically it consists of mounting three chip resistors, two jumpers and a chip tantalum capacitor. These are chips and require quite a bit of soldering skill. The manual states that "if you are not confident then contact your Yaesu dealer for assistance." According to their customer service department, the 9600-baud kit is available for $1.

Since I am involved in DFing, or foxhunting, I immediately realized that the packet modification soldering pad connections gave me access to the receiver audio prior to the audio gates, de-emphasis, and high-pass filtering. Now I have a good clean audio connection point for my foxhunting equipment. Yaesu even provides a small cutout which allows for the exit of cables that is located in the rear of the unit. This cutout is normally sealed with a plastic plug.

The radio receiver section comes out of the box ready to cover 140 to 174 MHz. The transmitter unmodified covers 144 to 148 MHz. I wanted to modify the unit for USAF MARS but instead of using the instructions from one of those thick modification books that you can buy at hamfests I decided to write to Yaesu and ask for their official modification sheet. I included my MARS license, my amateur license, and a copy of my purchase invoice. The instructions received from Yaesu were clear and easy to follow and contained all the necessary cautions about out-of-band operations.

Operating Manual and Technical Supplements

I thought that the small operating manual was well-written. I reviewed the "in case of trouble" pages, which are designed to correct for "operator errors." The handbook contains the usual circuit diagrams and flow charts as well as diagrams for the optional modules. However, all it contains for the microphone is the pinout pattern for the connector. You will have to purchase the technical supplement if you want circuit diagrams of the mikes.

The small operators' handbook is In English and Spanish so you can brush up on either language. I kind of miss those earlier Japanese manuals that were written in a strange kind of technical English with wording that seemed to have several meanings requiring hours to decipher. These new manuals take all the adventure out of purchasing a new Japanese radio. The "Yaesu Technical Supplement" (service manual) is up-to-date and was immediately available. It contains all the diagrams of the mikes, and includes instructions for lithium backup battery replacement and panel lamp replacement, which require good desoldering skills.

Overall Evaluation

I liked the radio. It's easy to operate and has a very readable front panel display. The alternate function buttons are reasonable in their organization and the clever bells and whistles are still there, with most of them hidden underneath the secret door. The unit appears to be really rugged. The best overall attraction for me was the receiver front end and its ability to work in a multi-transmitter high-RF environment and to resist basic front end overload.

Number 7 on your Feedback card

by Gordon West WB6NOA

GAP Antenna Products, Inc.
6010 Bldg. B
N. Old Dixie Highway
Vero Beach, FL 32967
Telephone: (407) 778-3728
Price Class: $399

The GAP Voyager DX

We compare the Voyager with a dipole in free-space.

Dipole antennas and verticals are the most popular choice for an easy way to get down on 40 meters, 80 meters, and 160 meters. On the "low bands" you will regularly hear amateur operators debating which antenna will perform better—the trap vertical for 40m-160m, or dipoles for these bands.

We decided to test our three independent, half-wavelength, unloaded dipoles, featuring the Centaur Electronics baluns, against a new GAP Voyager DX vertical which is designed for the 40m-160m band, plus additional resonance on the 20 meter band, too.

The Dipoles

Our dipoles for 40 meters, 80 meters, and 160 meters have been in place for about eight months, and each dipole uses the Centaur Electronics (Tucson, Arizona; 602/622-6672) "Big Bertha" coaxial choke balun, serial numbers 9457-9459. These monster baluns were suggested for our comparison by Centaur Electronics because of their Teflon insulation and all stainless steel hardware, plus their enormous size—perfect for a very rainy, wet Southern California environment.

Our comparison dipoles for 40 meters, 80 meters, and 160 meters were each cut to specific band resonance on the usual formula "length (feet) = 468/frequency (MHz)," where the overall antenna length equals the constant 468 divided by the desired operating frequency in MHz. We add about 1-1/2 feet of "fudge factor" at each end of our wire, and then cut the wire in two sections to be attached to the antenna balun and egg insulators, which will give us "fine-tuning" to the desired operating frequency.

Thanks to plenty of trees at the installation location of Bob Gregg AB6CH, we were able to obtain a minimum of one-quarter wavelength in height above ground on the 160 meter band to give us the best possible chance of a low angle of radiation. Each dipole was slightly drooped, and this is approximately the feed point height where our RG-213 non-contaminating coax was connected:

160 meters	130' elevated feed point (one-quarter wavelength)
80 meters	130' elevated feed point (half wavelength)
40 meters	130' elevated feed point (one wavelength)

We chose non-contaminating RG-213 because of its solid dielectric which would not soak up moisture during the California winter rainstorms. This proved to be a good choice for us after last winter's storms!

After the dipoles were hoisted aloft, it took about an hour or two of pruning and adjustment of each dipole with its individual feedline to bring our SWR down to a close 1:1.1. We used a relatively inexpensive MFJ SWR analyzer up on the roof, and then double-checked with a professional AEA SWR analyzer down below at the shack at the business end of the coax.

We were impressed with the Centaur Electronics balun because of its massive size for minimum internal I^2R losses, the three big "eyes" for hoisting the balun aloft and taking the strain off of the dipole wires, and the stainless steel wire lugs incorporating two 10-32 stainless steel binding posts with stainless steel wing-nuts for making electrical connections from the antenna elements to the balun. We could have used the bolts a bit longer, because both Bob and I managed to drop a nut on the relatively short binding posts.

The three dipoles with the Centaur baluns featuring true half-wave performance without any loading gave us consistently better signals from the West Coast than from other stations using lower dipoles and multiband dipoles to distant stations at the far end of the nighttime skywave range. Our results to stations well within the typical high-angle skywave range at night were almost comparable—low dipoles and loaded dipoles do about as well as big dipoles elevated way up when working a couple of hundred miles "easy path." But for reaching out to the furthest capabilities of a typical nighttime signal on 40,

Photo A. The Centaur "Big Bertha" 1:1 balun used on the dipoles.

Photo B. Sandy Gregg KC6NUF (Bob's wife) helps with the GAP antenna installation and element adjustment to compensate for roof mounting.

Photo C. Justin Gregg KD6VGG puts the final touches on the top capacity hat before the Voyager goes into place.

80, and 160 meters, the much lower angle of radiation from the well-elevated dipoles with the Centaur baluns gave us a definite edge over your typical roof-top dipole installation. These typical installations are perfectly adequate for short- and medium-range, but not adequate to really work to the extent of "DX" with a full-length dipole elevated a minimum of one-quarter wavelength above the ground.

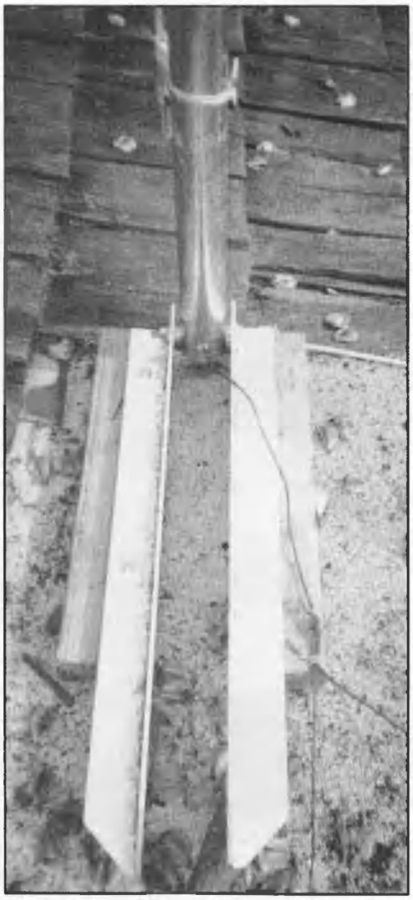


Photo D. The Voyager's hinged base allows for an "easy" tilt-up.

Conclusion on Dipoles

They work terrific when elevated at least one-quarter wavelength above the ground, with each side a natural one-quarter wavelength off of a professional balun, fed with any length, non-contaminating, big coax directly to your transceiver without the requirements of a manual or automatic antenna tuner. If you can operate right in the middle of that "sweet spot" where the dipole has natural resonance, you can minimize any tuner losses by going direct and keeping your coax "cold" to any standing waves coming back down the outside braid. The Centaur balun sees to that, too, even slightly off of operating frequency resonance.

The GAP Comparison

Rich at GAP Antenna Products makes a valid point that not all hams have 150-foot pine trees to suspend dipole feed points, and we should test the Voyager on the lower bands versus our dipoles. We ordered a Voyager DX that was shipped United Parcel Service to Bob's QTH in Fountain Valley, California.

"When you look at the box, it's hard to imagine that an aluminum vertical antenna that stands 45 feet tall is on the inside disassembled. And when I mean disassembled, I mean disassembled!" comments Bob Gregg AB6CH. Bob is no newcomer to putting antennas together—he regularly holds "antenna parties" for his General code class students who are upgrading from Technician to General class, and exploring the fabulous world of high frequency operating.

The GAP Voyager DX has been reviewed by several antenna experts, and most agree that size alone at 45 feet tall spells good performance on the lower bands when compared to popular 20-foot trap verticals featuring high impedance L/C networks to create resonance on popular ham bands without the use of a tuner. But the GAP Voyager does not use L/C traps, and resonance on 20 meters, 40 meters, 80 meters, and 160 meters is accomplished by capacitive loading by a labyrinth of elements, rods, wires, and a very large capacitive top-loading hat. The last time I remember seeing and working with a top-loading hat was back in the days of 2 MHz marine radio, and the top-hat was necessary to give us enough loading capability to run down the antenna PA coil to tap in for peak resonance.

It took us two days to get it up and flying. I will attest to the many recommendations in the instruction sheets on a fair amount of tension on the non-conductive guy wires, and the details on how important the mechanical interaction is with the performance of the dipole.

We fed the Voyager DX with the same type of non-contaminating RG-213 coax that were also feeding our dipoles. Each coaxial cable connector featured Teflon insulation to ensure no arc-over in wet weather. Three counterpoise wires, each 57 feet long, were also required for the proper operation of the GAP Voyager. The GAP was mounted on Bob Gregg's roof. A cast-iron vent pipe was the

Photo E. The Voyager in place on the roof. Different measurements must be applied to roof mounting—40 meters needed a specific quarter-wave radial.

Photo F. Bob Gregg AB6GCH tests the Voyager with comparisons to dipoles up 100 feet.

perfect support to keep the base in place without fear of it slipping horizontally during the delicate antenna raising.

[Editor's note: For the purpose of this review, our intrepid reviewer installed the 45-foot vertical Gap Voyager on a rooftop. Please keep in mind that the manufacturer recommends ground mounting rather than roof mounting due to the Voyager's size.]

Once everything was in place, we took some roof measurements with the MFJ SWR bridge and found that we needed to lower the GAP back over on its hinged base for some fine-tuning of the 160 meter and 80 meter bands. We set 80 to 8775 kHz, and 160 to 1975 kHz. On 40 meters, we straddled the CW and voice portion of the band where Bob conducts regular code practice nets with students as far away as 1,000 miles.

Then came the big test—the GAP Voyager mounted up about 25 feet on the rooftop, versus the three half-wavelength dipoles hoisted well over 100 feet in the air at their feed points, with a slight droop to keep the dipoles within the property line. Would the Voyager blow the dipoles away?

Our first discovery was power-line noise. We used a professional Daiwa switch to go between the vertical and the dipoles, and at different times of day different power lines around the block would give us noise more on one antenna than the other, and then just the opposite at night. But we did find the lower-mounted vertical more susceptible to noise coming from surrounding houses than the well-elevated dipoles. And there were times that the dipoles picked up more power-line noise from distant arcing insulators than did the vertical. So the best bet was to have the capability to switch back and forth to minimize noise pick-up.

Ground-wave contacts gave both antennas an almost equal rating. Some said the dipoles were louder than the vertical, yet the vertical was sometimes heard better than the dipoles. We thought that polarization would make a major difference to different groundwave polarizations, but not necessarily so. We did confirm that ground-wave mobile stations heard the vertical better than the dipoles, and ground-wave base stations also running dipoles heard the dipoles better than the vertical.

When nighttime settled in, short-skip skywave stations heard both antenna systems ker-smash with signals well above S9. These stations from 300 miles to 800 miles away all commented that both the Voyager and the dipoles were almost equal in strength, and both were a lot louder than loaded verticals and low-level dipoles. However, there would now and then be a station that would comment that our system was not performing nearly as well as a lady ham down the street who had a series of dipoles just above roof level. And this makes sense—the lower to the ground you mount your dipoles, the higher the angle of radiation, and conceivably better signal to a short-skip station only a couple hundred miles away. So whenever you are comparing antennas, keep in mind that it is perfectly normal for nearby stations to sometimes get better signal reports off of a lower-mounted antenna system than you may have with a superb antenna system mounted up high where it should be for best DX.

> ***"If you have capabilities of keeping the antenna tied down in big winds, a big vertical antenna is well worth its height."***

As the evening wore on, signals to the edge of good DX skywave range began to pound in on both the well-elevated dipoles and the vertical. At times these DX signals would peak on the vertical, then at other times peak on the dipole. At no time could these signals be heard off of the low-elevated dipoles down the street.

Early in the morning, the vertical had two hours of better reception than the dipoles—sometimes hearing distant stations on 80 meters and 160 meters that the dipoles would only have heard as noise. And, at all times, signal reports exchanged with these distant stations were always commensurate with reception—the stronger you hear them, the stronger they will hear you on a particular antenna. However, as noise would come up from arcing power lines in the early morning fog, the dipoles would sometimes have an advantage over the vertical. The vertical Voyager was a hot antenna, but also picked up a lot more man-made noise because of its proximity to the nearby power feeds.

Conclusions

1. Bigger is better.

2. It's a close match between the vertical and the dipoles if the dipoles are at least one-quarter wavelength to one-half wavelength above the surface of the ground. That's not easy to do unless you have big trees.

3. The Voyager is an effective way to work DX with a roof top antenna only 45 feet tall down on 160, 80, and 40 meters. The Voyager won "hands down" on the lower bands when compared to other loaded and trap verticals half its size.

4. You'd better have understanding neighbors—the Voyager is a shocker when you see it for the first time up on the roof.

Which way to go? If you've got a lot of trees well over 100 feet around you, dipoles are an effective way of getting plenty of bang for just a few bucks with those bucks going to a quality balun. If you don't have big trees, consider a big antenna mounted on your roof with an elevated feed point. If you have capabilities of keeping the antenna tied down in big winds, a big vertical antenna is well worth its height.

The Antenna Elevator

The closest thing to a skyhook.

by Frank DiStefano WB2DZF

No longer do you need to test your nerves and risk your life to repair nature's wear and tear on your beam antenna. Build this simple Antenna Sled and bring your problems down to earth.

Background

Ten years ago at a hamfest I acquired 70' of Rohn 45G tower. On top of this I put a Wilson System 40 triband beam antenna. This was no small project as this antenna has 10 elements with four full-sized 20 meter elements on a 26-foot boom, all weighing in at 80 pounds. After much strain and wild and dangerous gyrations, the antenna was put in place and proved to be an excellent antenna. Now this all sounds great, but what do you do when you have to make repairs or adjustments?

Initially I thought it would have been nice to have an elevator on the side of the tower to raise or lower the whole assembly (antenna, mast and rotator), but my climber had been eager to get the installation completed before winter set in, and I capitulated. That was a mistake. Within a short time the antenna showed a high SWR and it was intermittent in a wind: a loose connection, but where? So, the antenna just sat there for a few years until the ice storm of '91 finished it off! Part of the antenna fell to the ground and the rest was lowered in a somewhat controlled fall. I rebuilt the antenna but I had to come up with a way to raise it. I was not going to go through the previous experience again.

A Better Way to Raise It

I had to come up with something to lift the antenna to its mounting height, but the tower guys were a major obstacle. So I devised an "elevator" that allows the antenna to be raised by disconnecting the lower guys, raising the antenna, reconnecting the lower guys, disconnecting the upper guys, raising the antenna further and reconnecting the upper guys.

While there is some climbing to bolt the unit to the tower, the heavy work of wrestling the cumbersome beam is eliminated. The antenna can be brought down to within seven feet of the ground. This allows me to work on a small stepladder to make repairs and adjustments.

The unit is guided by two guide wires anchored at the top and bottom. These wires (or cables) are attached to a piece of angle bolted to the tower and passed through four guides welded to the elevator. With the elevator at its raised position it is bolted to the tower with eight 1-1/2" x 1/4" "U" bolts.

The elevator is raised to its position by means of a boat trailer winch fitted with 3/16" cable which runs through a block at the top of the tower, then back down to the bottom of the elevator. For the top bearing I made a bushing out of plastic. A bearing supplied by the tower manufacturer could be easily adapted if you prefer not to make your own. The mast is made of 2" pipe and the weight of both the antenna and the mast is carried by the rotator.

Appropriate threading of the feedline and rotator wires are key to allowing the antenna to be lowered within easy reach of the ground. Start by threading the feedline and rotator wires inside the tower until you reach the tower midpoint. Then bring all the wires outside of the tower and back down to your waiting antenna. Now, hookup and testing can be done on the ground.

Now you are ready to lift your assembly to the top of the tower. When in place, you can tape or wire-tie the wires to the tower.

I much prefer the guyed tower to the free-standing tower because I don't want any concrete to contend with when installing or removing the tower at a later date. The elevator is made of 3/16" x 2" angle iron and is of welded construction. While you could

Photo A. The mast bearing and guide wires passing through their guides. The hoisting cable can be seen passing down to the bottom of the elevator.

Photo B. The rotator and guide wires attached to their eye bolts and passing through the guides on the elevator.

Photo C. The completed assembly, ready to be raised into position.

bolt it together, it seems everyone knows someone with a welder. Or, it should not cost much to hire someone to do it.

Figures 1 an 2 show the dimensions I used, but these can be altered to suit your tower and rotator.

The antenna has been up for about one year now and everything is working fine. If I have to lower the antenna, it should take about an hour and require only two people working at a leisurely pace, *safely!*

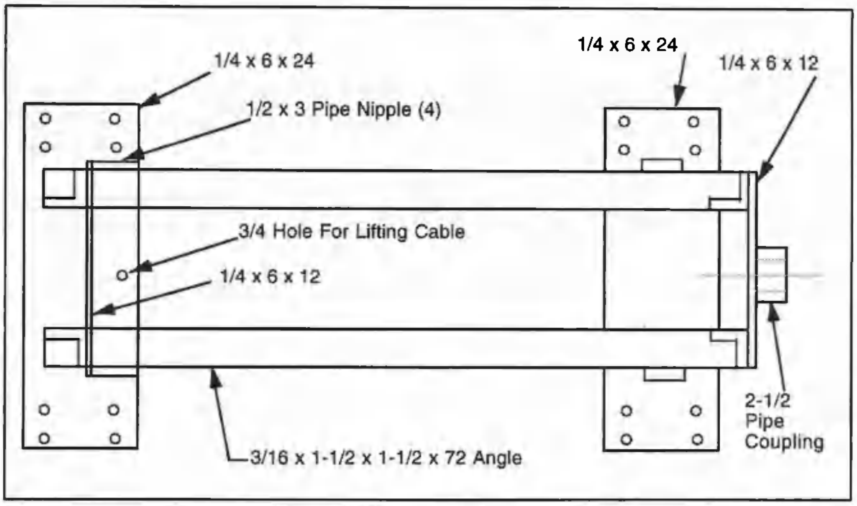


Figure 1. Top view of the elevator.

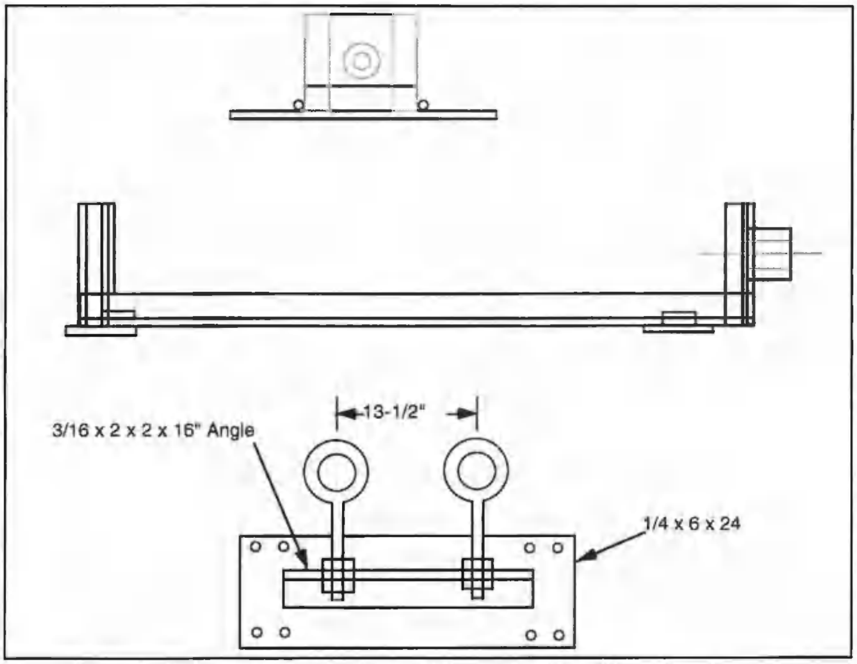


Figure 2. End view (top), side view (middle), and guide cable anchor (bottom).

Number 9 on your Feedback card

Specialized Top-Band DX Receiving Loop

Listen to the action on 160 meters.

by Richard Q. Marris G2BZQ

The "top-band" covers from 1.8 MHz to 2 MHz and is, therefore, the only amateur transmitting band in the MF spectrum (300 kHz to 3000 kHz).

On top-band it is not uncommon, when using a conventional antenna, to hear European stations working traffic with North America, yet all one can personally hear is a weak signal deep in the typical high ambient noise level, or no signal at all. Many therefore build a simple loop receiving antenna consisting of several turns of wire around a framework, resonated by a variable capacitor, and transformer-coupled to the receiver with a single wire turn alongside the main resonant winding. The results, though possibly better, are often disappointing, with weak signals and high ambient noise. If you add a preamplifier to boost the weak signals and it will also amplify the ambient noise pro rata.

Yet with a properly designed MF loop it is quite possible to comfortably hear, and read, previously inaudible transatlantic and other DX signals. Such a loop has to be designed to give peak performance for just the 200 kHz between 1.8 MHz and 2 MHz, resisting the temptation to take in as wide a frequency range as possible. The loop dimensions are somewhat dictated by the domestic environment.

The top-band loop antenna, properly designed, can produce good reception of transatlantic signals which otherwise cannot be identified, or heard, with the available conventional antenna.

History

The loop receiving antenna has been around since the earliest days of wireless in connection with DF (direction finding) requirements, on oceangoing vessels in those days when the ocean liner, not the airliner, reigned supreme. It is therefore useful to study old relevant textbooks covering the 1920s to 1940s, such as Terman* and *The Handbook of Technical Instruction for Wireless Telegraphists**. By far the best is the 1938 edition of *The Admiralty Handbook of Wireless Telegraphy.** This two-volume book was a standard training manual used throughout the armed services, merchantile marine colleges, and many other training establishments. The DF section, "T," has never been surpassed for locating basic information on the principles and properties of DF and loop antennas.

MF loops are divided into two distinct types: the "box" form (Figure 1) and the "pancake" form (Figure 2), which is now more commonly known as the spiral loop. They both give a theoretical "figure-eight" polar diagram of reception (Figure 3). The *Admiralty Handbook* states that in the box form "the loops are of the same dimensions, but not coplanar, and are equivalent to a single loop of 'n' times the area in a plane parallel to themselves, plus a loop at right angles of area equal to half the area of the vertical side of the box frame. Hence *zero signals will not be obtained* when the frame is exactly at right angles to the line joining it to the transmitter." This is contrary to generally held assumptions. Also, "In the pancake form the total EMF is the sum of the separate EMFs in the loops, these being proportional to the dimensions in each case. It is equivalent to one Loop whose area is the sum of the individual areas, and *gives zero signals*, when the plane is at right angles to the transmitters." More recent textbooks appear to gloss over these statements, and seldom mention the spiral loop. Too difficult to make?

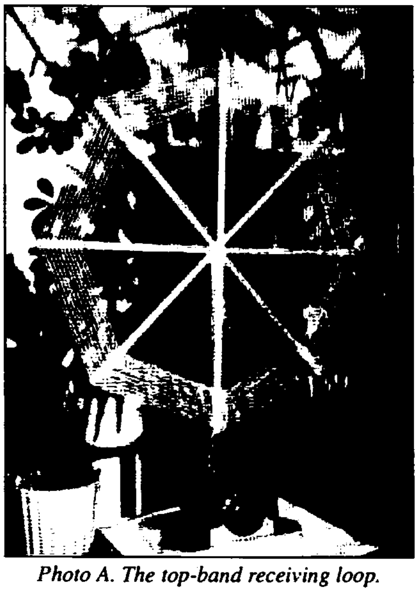


Photo A. The top-band receiving loop.

The above indicates that at MF frequencies the pancake, or spiral, loop should be superior to the box loop. The loop can be any symmetrical shape, e.g. square, diamond, triangular or circular. The ideal shape appears to be circular, and is also the most difficult to construct in spiral form. In practice, a near circle can be obtained by using an octagonal framework. The size of the loop will, in practice, be influenced by the domestic operating (and storage) space available. Furthermore, textbooks and personal experiments indicate that the variable capacitor should be set at near minimum capacity, with maximum wire turns, to obtain maximum signal strength and minimum ambient noise at the target frequency (i.e. 1.8-2.0 MHz). Rotation of the loop will also reduce or eliminate adjacent interfering signals to the one being read.

Loop Description

The loop circuit shown in Figure 4 shows an 11-turn spiral loop in octagonal shape, which is very close to circular in shape, with an outside diameter of 30 inches. The turns are held apart by threading through 12-way 2-amp polythene terminal blocks, which are a convenient 5/16" apart, center to center, thus reducing the proximity effect. The loop is brought to resonance by a balanced circuit 2 gang x 500 pF per section variable capacitor (C3 + C4) with 150 pF capacitors C1 and C2 in series. These 2 gang x 500 pF variable capacitors are readily available from suppliers, on the surplus market, or salvaged from an old MW/LW domestic radio. Built-in trimmers should be removed if fitted. When C3 + C4 plates are not more than 5% enmeshed, 2 MHz is resonated. Tuning is smooth and easy with a large 3" diameter instrument knob—no slow-motion drive is required.

Coupling to the receiver's 50-ohm impedance input is via C5 (470 pF) and a short length of RG58 feedline. Originally C5 was a variable capacitor to adjust the degree of coupling. *Under*-coupling is indicated by a narrowband weak signal, and *over*-coupling by a double-hump wideband effect. The optimum coupling is just under the over-coupling

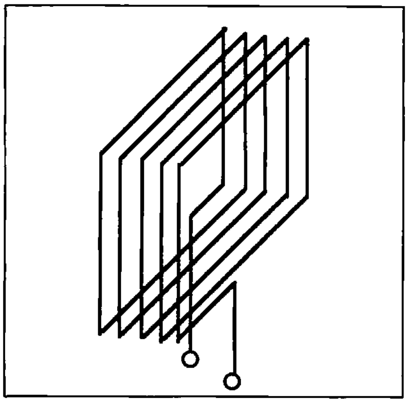


Figure 1. Box form.

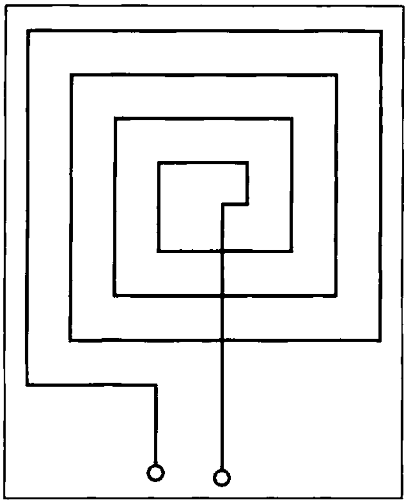


Figure 2. Pancake (or spiral) form.

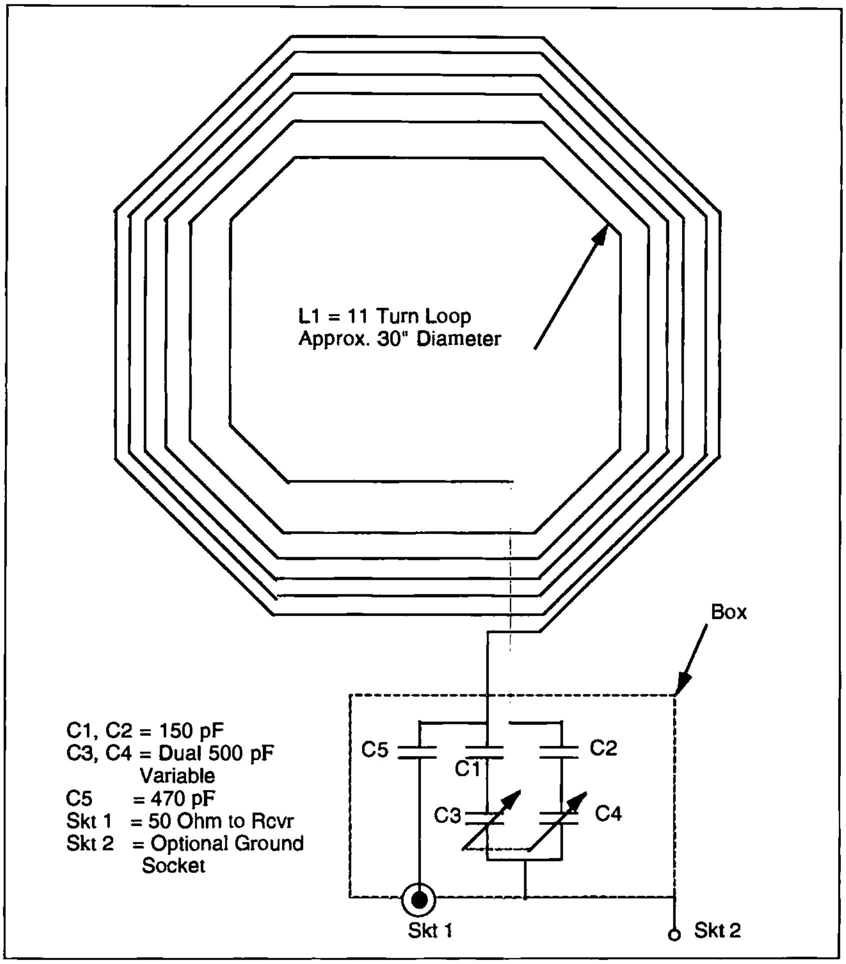


Figure 4. Topband circuit.

point where the double hump turns into a single peak. Conveniently, this worked out at 47 pt (C5). Anyone using a 300-ohm twin feedline (or other impedance) should revert to a variable C5 to arrive at the necessary capacity value. Though an optional grounding socket has been shown (Skt 2), no real advantage is apparent. Using an earth connection to a domestic water pipe increased the ambient noise, and another earth connection slightly decreased it. By far the best method appears to be making an earth connection to the receiver adjacent to the low impedance coaxial input. The whole of the tuning unit must be enclosed in a metal box.

Performance has been very gratifying in as much as transatlantic CW signals are quite clearly heard and read with a sensitive receiver, whereas they cannot be heard at all or be barely heard on a conventional wire antenna. A preamplifier has not been found to be necessary, as the whole loop is peaked over a mere 200 kHz band (1.8-2 MHz). Rotation of the loop reduces/eliminates interference from other stations, and local man-made noise.

Construction

The mechanical structure (Figure 5) consists of four lengths of good dry timber, 30" x 5/8" x 1/4", with a hole drilled in the center of each where glue is applied and the lengths secured with a bolt, a nut and washers, adjusting the limbs to 45 degrees as shown. At the end of each limb a 12-way 2-amp polythene terminal block is fitted. These blocks are used to secure the loop turns in place, approximately 5/16" apart, thus providing an 11-turn octagonal spiral winding, which is as near the ideal circular shape as possible.

The loop winding (Figure 6) consists of PVC-covered hook-up wire (7/0.2 mm with an overall outer diameter of 1.2 mm). Commence the winding at the bottom outside terminal block insert and proceed counterclockwise, in a spiral, terminating at the inner insert. The terminal block insert grub screws should be tightened about once per turn to hold the winding rigid. Leave sufficiently long wire tails for later connection to C1 and C2.

The above eight-prong wound loop frame is bolted to one end of a 23" x 0.8" x 0.8" vertical timber support (Figure 5), the other end of which is screwed and bracketed to a 12" x 9" x 1" base. For the base, a gray inverted TV snack tray was used, which lost its original identity and provided an attrac-

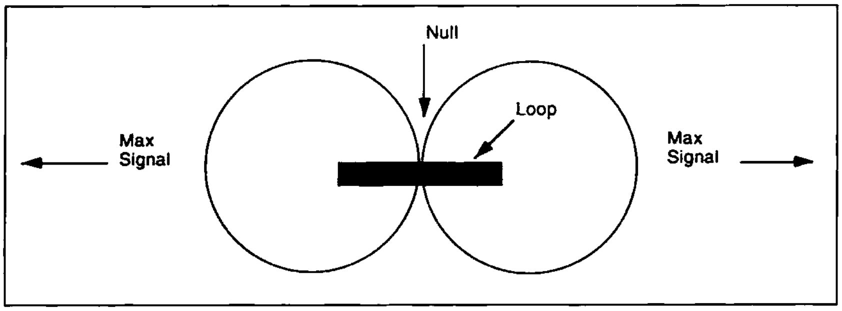


Figure 3. Typical polar diagram of reception.

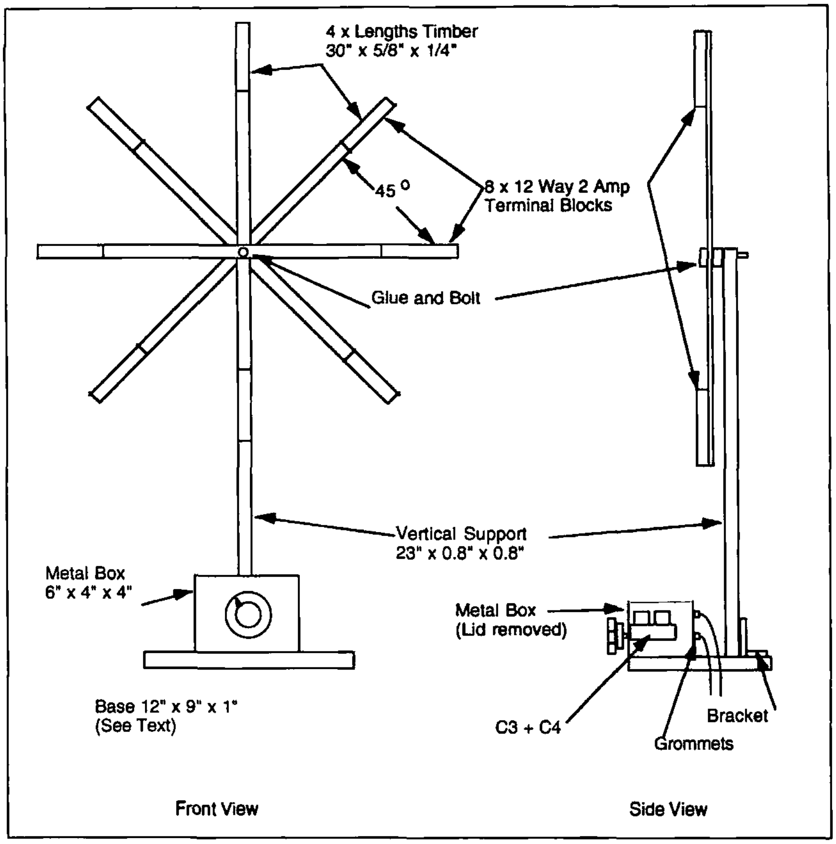


Figure 5. Mechanical structure.

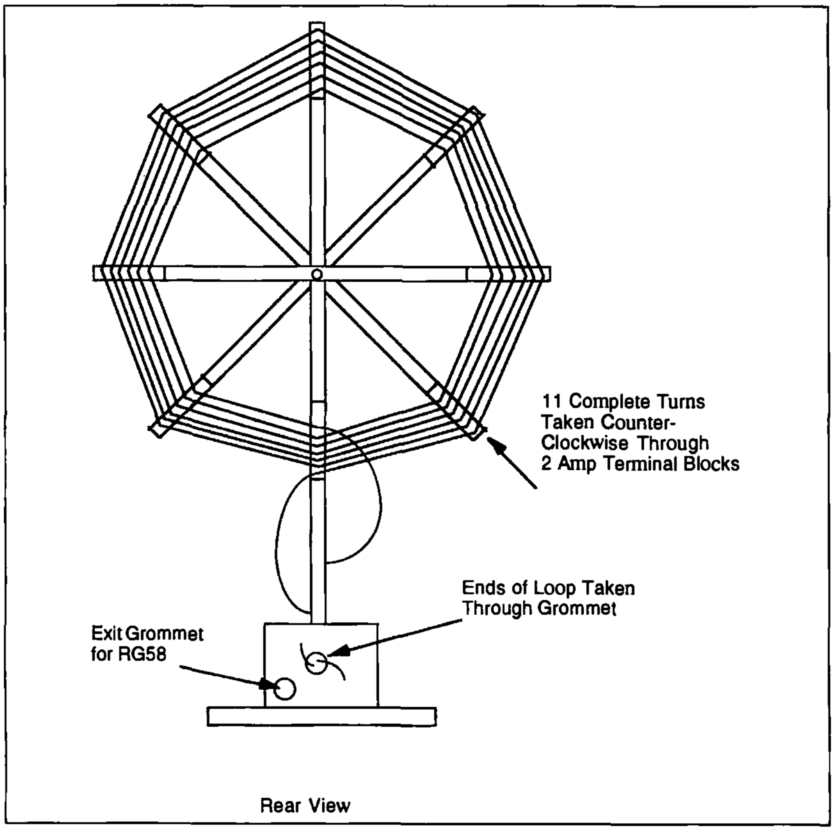


Figure 6. Loop winding detail.

tively-shaped molded base. As the base is 1" deep, it is weighted with a strip of 3/4" wood underneath. Other base construction ideas will come to mind. The metal box used measures 6" x 4" x 4", and has a removable lid mounted as shown in Figure 5. The box size is not critical. The variable capacitor C3 + C4 is mounted on the front panel as shown. The two ends of the loop are taken through an insulated grommet in the center rear of the box (Figures 5 and 6). Sixty inches of RG58 coaxial feedline is taken through a rear grommet, or via a coaxial socket to the receiver (Figure 6).

Operation

With the loop connected to the receiver, tune the latter to 2 MHz and rotate C3 + C4 to maximum signal, which should occur with the rotor plates not more than 5% enmeshed. Repeat this procedure at 1.8 MHz. When tuned to a signal, the loop should be rotated for maximum signal. Rotation either side of this point will reduce/eliminate interference from other stations, and specific manmade interference. You will find that the loop will tune to the HF end of the medium wave broadcast band but performance starts to fall off below 1700 kHz, as the loop has been designed for peak performance between 1.8 MHz and 2 MHz only.

***Useful Reading**

1. *Handbook of Wireless Telegraphy 1938*, published by His Majesty's Stationery Office, London.
2. *Radio Engineering* (Second Edition) by F.E. Terman Sc.D., 1937.
3. *Handbook of Technical Instruction for Wireless Telegraphists* by H.M. Dowsett & L.E.Q. Walker, Seventh Edition, 1942.
4. *Measurements in Radio Engineering* by F.E. Terman, First Edition 1935.
5. Others: *Antennas* by Kraus and *The ARRL Antenna Book.*

Parts List

C1,C2	150 pF silver mica capacitors
C3 + C4	2 gang x 500 pF per section robust variable capacitors
C5	470 pF silver mica capacitor
Skt 1	Coaxial feedline RG58 60" long maximum
Skt 2	Optional earth-connecting socket
Wire	PVC hook-up wire 7/0.22 mm and 1.2 mm o/d
8	2 amp polythene terminal blocks
4	Dry timber lengths 30" x 5/8" x 1/4"
1	Vertical support: dry timber 23" x 0.8" x 0.8"
1	3"-diameter instrument knob
1	Box, typically 6" x 4" x 4", with removable lid
1	Base, approximately 12" x 9" x 1"
2	Plastic grommets

Build an Efficient HF Mobile Antenna

An electrically and mechanically sound design is offered, with easy band change coils.

by Frank Kamp K5DKZ

Short, coil-loaded antenna designs are all compromises when compared to full-sized antennas. Resistance losses in loading coils and low input impedances (typically 5 to 20 ohms) are the main efficiency-robbing factors. Efficiency can be optimized by using capacitive top-loading and high-Q loading coils. Top loading reduces the number of turns needed in the loading coil. Air-wound coil designs that utilize #12 or heavier wire will maximize Q and efficiency. Spiral-wound whips are also favored alternatives because their input impedance is relatively high, typically around 20 ohms. A design optimized for efficiency alone might take on the form of a large-diameter, spiral-wound, six-foot coil of heavy wire topped with a three-foot diameter capacity hat and three-foot whip. Such a design would work well electrically, but would pose a significant mechanical challenge and complicate band switching.

My past mobile activities have employed a standard center-loaded whip using interchangeable resonators for band changes. Tuning within the band is accomplished by adjusting the length of the whip at the top of the resonator. This type of antenna works reasonably well on 20 and 15, but becomes top-heavy and flimsy on 75 and 40 meters when used with most standard mobile masts. A single insulated base bumper mounting, along with a heavy center-loading coil, result in a radiator that does not always remain vertical at highway speeds. The "store-bought" version I used over a period of 15 years also developed questionable mechanical and electrical integrity. Connections to the mast were mechanically swedged instead of brazed, soldered or welded.

I needed a mechanically and electrically sound, vertical, all-band antenna. The main bands of interest were 75, 40, and 20 meters. Overall height was to remain under nine feet, with the upper three feet being a flexible whip. I wanted a design optimized for efficiency and easy band changing, but it also needed to be practical. Use of commonly available materials was an important factor in keeping costs down. The end result is a very stable, easily-mounted antenna that uses quick change resonators for band changes. The resonators are pre-tuned for the phone portions of each band and use a common three-foot whip. Only the resonators need be swapped to accomplish a band change.

The Resonators

The 75 meter resonator covers 3.7 through 4.00 MHz in 12 steps. The bandwidth of each coil tap is 20 kHz between 2:1 upper and lower SWR points, and 30 kHz between 3:1 upper and lower SWR points. Fine-tuning at each coil tap is done by adjusting the length of the three-foot whip. Careful adjustment will bring the SWR to 1:1 consistently after the matching coil tap is adjusted for a 50-ohm

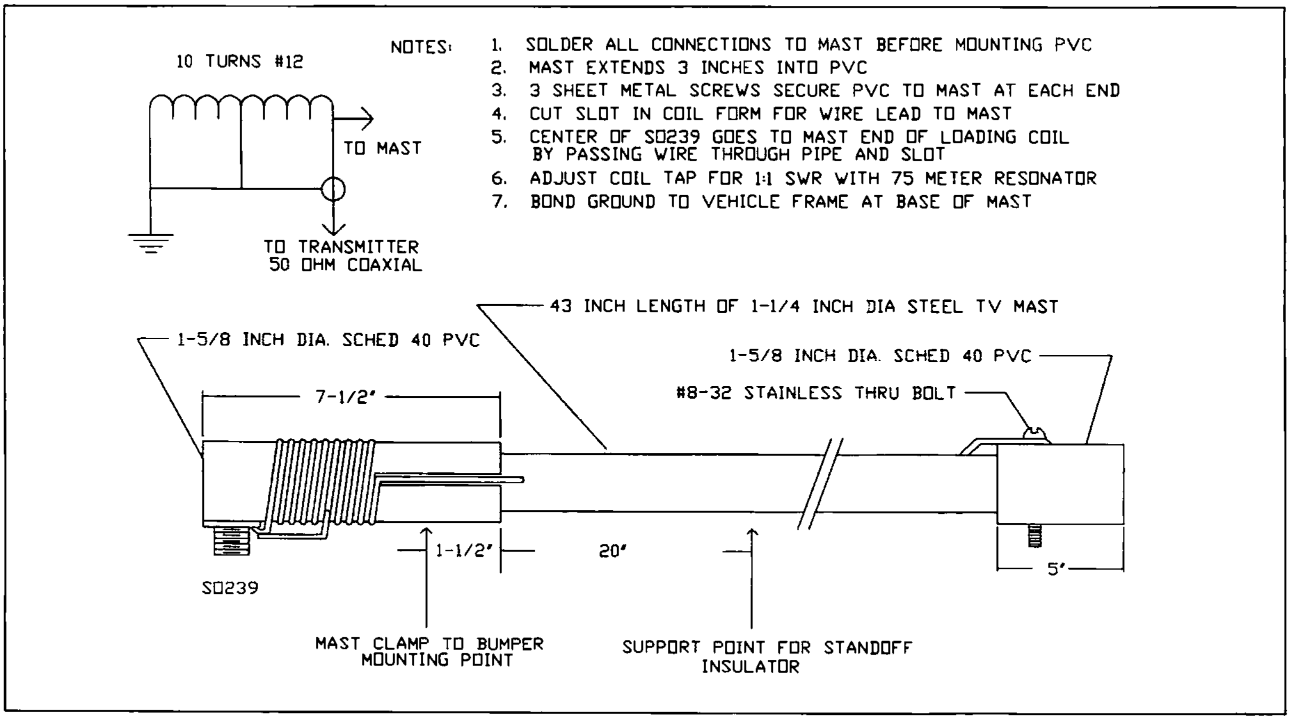


Figure 1. Mobile mast construction detail.

Photo A. 75 meter mobile resonator mounted on the HF mobile antenna mount.

match to the transmitter. Ordinarily, high-Q coils of this type will have a tendency to drift in a mobile environment. The rigid overall construction of this antenna keeps the radiator on frequency.

On-the-air tests show that this is an effective 75 meter antenna. During a recent Sunday morning schedule with a station 200 miles away, my mobile installation received an S-7 signal report. This compares favorably with the S-9 plus 10 dB report I received using the fixed station at the same time, when you consider the conditions. I was running 1,200 watts PEP to an inverted vee up at 60 feet in the fixed station configuration. My mobile setup was limited to 100 watts PEP and the vehicle was sitting in the driveway surrounded by 50-foot trees on all sides.

The 40 meter resonator covers 7.15 through 7.30 MHz without the need for taps. Its bandwidth is 170 kHz between 3:1 upper and lower SWR points and 100 kHz between 2:1 upper and lower SWR points. It is somewhat more efficient than the 75 meter resonator.

The 20 meter resonator covers the entire band from 14.0 to 14.350 MHz with a single untapped coil. The actual 3:1 upper and lower SWR points are 14.0 to 14.4 MHz, and the 2:1 points fall at 14.05 and 14.3 MHz. The bandwidth increases to 300 kHz because the physical length of the antenna becomes a larger percentage of what is required for a quarter wavelength resonator on that band.

Mast Construction

See Figure 1. The bottom portion of the mast is a 43" length of 1.25" diameter steel TV mast. I realize this is overkill but the TV mast diameter provides a nice slip fit with 1.5" schedule 40 PVC pipe. A 4.5" section of PVC pipe is attached to the upper part of the steel mast, with four self-tapping sheet metal screws and serves as the mounting for the base of the resonators. A 7.5" length of PVC pipe is attached in the same way to the bottom of the steel mast. The bottom section of PVC serves as a coil form for the matching coil, an insulator for the bottom antenna mount, and a convenient place to install an SO-239 connector for the feedline connec-

Photo B. Close-up of the 75 meter resonator.

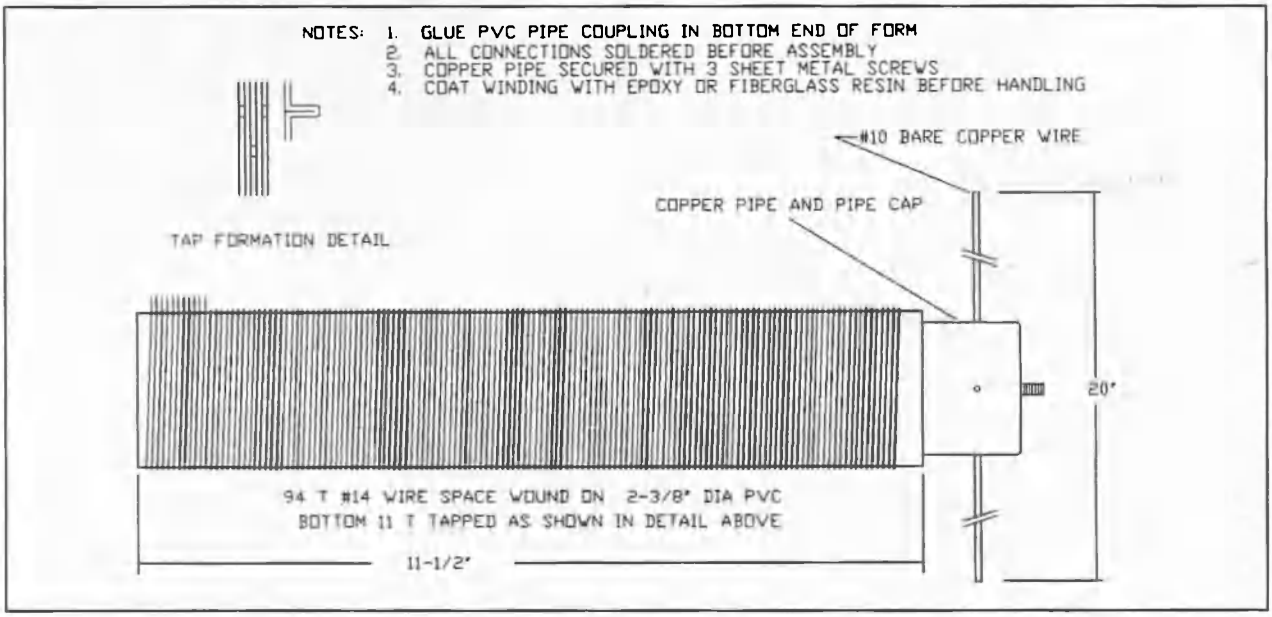


Figure 2. 75 meter resonator.

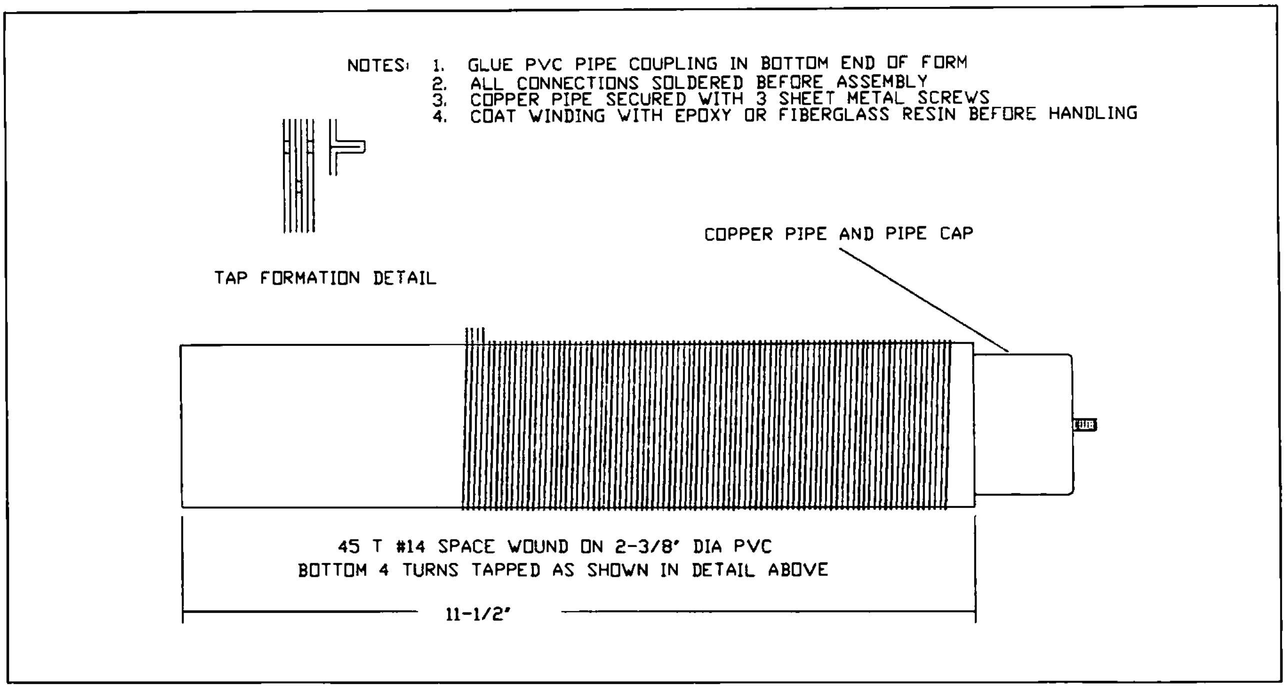


Figure 3. 40 meter resonator.

tion. Electrical connection to the mast is made using heavy copper braid removed from lengths of scrap coax. The braid is soldered to the steel mast. You will need a large soldering iron or propane torch to make these connections and you will want to solder the braid in place before permanently installing the PVC sleeves. Cut a slot down three-quarters of the length of the lower PVC sleeve. This allows the boom-to-mast mounting clamp to compress the sleeve tightly around the lower mast section. It also provides a convenient way to bring the braid down the center of the pipe, where it is soldered to the center of the coaxial connector. The upper, ungrounded end of the matching coil is also soldered to the braid.

The matching coil is 10 turns of #12 wire spaced one-wire in diameter between turns and located between the coax connector and the electrical connection to the mast. The lower end of the matching coil is soldered to the flange of the coax connector. A second length of heavy copper braid is soldered to the coax connector flange and grounded to the frame of the vehicle. These solder connections are made using a propane torch and before mounting the coax connector to the PVC pipe. You will want to use a Teflon-insulated coax connector that will withstand the heat of soldering. Use standard 4-40 hardware to mount the connector. Stainless steel hardware is preferred but not absolutely necessary if the ground connections are soldered. Soldering directly to the flange results in better long-term electrical connections than can be achieved using solder lugs and hardware. The ground connection to the vehicle frame should also be soldered.

Wind the matching coil onto the PVC before mounting it to the mast. Self-tapping screws can be used to secure the beginning and ends of the winding but should not be relied on as a permanent solution. Several vertical bands of epoxy will keep the coil in place. I used Fiberglas resin to fully encapsulate the coil after finding the proper tap for a 50-ohm impedance match.

The bottom part of the antenna is mounted to the steel bumper of the vehicle using a common antenna mast clamp. Two holes are drilled through the bumper for the U-bolt. This provides an inexpensive and rigid mounting. The mast will require a second mounting for stability. This attachment should be about two feet up from the lower mount. I used a 2.5"-wide length of heavy printed circuit board material. After the copper was chemically removed, I drilled one end of the PC board material to match the bolt pattern found on the inside wall of the tailgate mount of my truck. After adjusting the mast so that it was perfectly vertical, I drilled the other end of the PC board and mast together to receive a #10-32 through-bolt. The bolt passes through the mast and secures the PC board spacer. Almost any rigid insulating material can be used for this spacer but I would advise against using Plexiglas. Plexiglas gets brittle with age and will eventually fail. Polycarbonate would be an ideal alternative. This mounting is most suitable for installation on a truck or van. If done properly, it will not interfere with the movement of the tailgate or hatchback.

Resonator Construction

Two-inch-diameter schedule 40 PVC pipe is used as a coil form for the resonators. Its actual outside diameter is just under 2.5". Its inside diameter provides a slip fit for the outside diameter of coupling sleeves used with the 1.5" diameter PVC pipe. The coupling sleeve is glued to the inside of the coil form using PVC cement. The outside diameter of the coupling sleeve is not a critical dimension in the manufacture of the sleeve and may vary from brand to brand; all of them will fit inside the coil form. However, the fit may vary from loose to very sloppy and may require additional PVC material to take up the slack. If needed, thin strips of PVC material can be cut from a scrap of pipe and used to improve a sloppy fit between the coupling and the coil form. A press fit is not needed or desirable as it could fracture the coil form, but a close fit is necessary in making a permanent assembly using the PVC cement. The press fit of the coupling sleeve to the 1.5" PVC pipe is all that is necessary to keep the resonators in place on the mast, even at highway speeds. This mounting is secure and allows easy removal of the resonators.

75 Meters

See Figure 2. A 12" length of coil form is needed for the 75 meter resonator. The resonator consists of 93 turns of #16 solid copper enameled wire wound onto the form and spaced approximately one wire diameter apart. The spacing is not overly critical, but avoid close-winding the coil. Closer spacing will result in more inductance per linear inch, requiring fewer turns. To space the turns, I use braided nylon twine that is slightly larger in diameter than the wire. The wire and twine are wound simultaneously onto the form.

After the winding is complete, carefully remove the twine. You need about 60 feet of #16 wire. Before you start, make sure it has no kinks in it. The surest way of keeping kinks out of it when you wind the coil is to

Continued on page 50

Build an Efficient HF Mobile Antenna

Continued from page 46

lay the wire straight out into a yard. If it does have kinks in it, remove them by tying one end of the wire to a fence post and giving the other end a few good yanks. The 11 taps are located at the bottom end of the coil form where it attaches to the mast. Each tap is staggered from the other by approximately an inch so they don't end up bunched up on top of each other. Before worrying with the taps, complete the coil winding and use epoxy to secure all but the bottom 11 windings. After the epoxy cures (overnight!) unwind the unsecured windings. Scrape the enamel completely from a 1" length of wire and bend it down on top of itself to form a closed loop about 0.25" long. We want the copper in the loop to be bright and shiny because we will later fill the loop with solder. When done, secure the tapped windings with epoxy.

Leave enough wire at the end to install the large solder lug that will be screwed down against the #10-32 stainless steel through-bolt we will install at the top of the mast. This through-bolt is the only mechanical connection in the antenna functioning as an electrical termination. It ties the bottom of the coil to the end of the copper braid from the top of the mast, and is required to allow removal of the resonator. It uses a wingnut fastener. An additional length of wire from the solder lug is bent back up the coil form and soldered to the desired coil tap. This is a semi-permanent connection so, before final assembly, make sure it is in the frequency range you will be using. I don't recommend alligator clips, sliding contacts, or miniature banana plugs; a soldered connection will outperform all of these alternatives.

Glue another 1.5" PVC coupling sleeve into the top end of the coil form. Self-tapping sheet metal screws secure the copper top hat and whip mount into the sleeve. The top hat and whip mount are made from 2"-long 1.5"-diameter copper pipe and pipe cap. Drill the pipe cap in the exact center of its top, and install a bolt here that matches the size and tread requirements of your spring loaded whip. Drill additional holes around the pipe and cap assembly at 90-degree intervals. Insert two lengths of #10 solid copper wire 21" long through these holes and center them on the assembly. Then, using a torch, solder the entire assembly. Don't try to solder just a portion of the assembly; copper is too good a conductor of heat to allow that. All connections will have be soldered at the same time. The top wire from the resonator coil is also soldered to this assembly. The wire can be kept in place by wrapping it around one of the top hat radials prior to soldering. All soldering should be done prior to installing the assembly into the PVC coupling.

40 Meters

See Figure 3. The 40 meter resonator is built like the 75 meter resonator. The minimum required coil form length is eight inches. Space-wind a total of 44 turns of #12 bare copper wire onto the form and secure it with epoxy. Approximately 33 feet of wire is required. The same nylon spacing twine used on the 75 meter coil can be used here, but a crossed-wire top hat is not used. Otherwise, the whip mounting is the same as on the 75 meter resonator. The 40 meter coil becomes resonant at 7254 kHz with the bottom two turns shorted. Each turn of the coil shifts the resonant frequency by about 200 kHz. The

Photo C. 20 meter resonator mounted on the mobile mast.

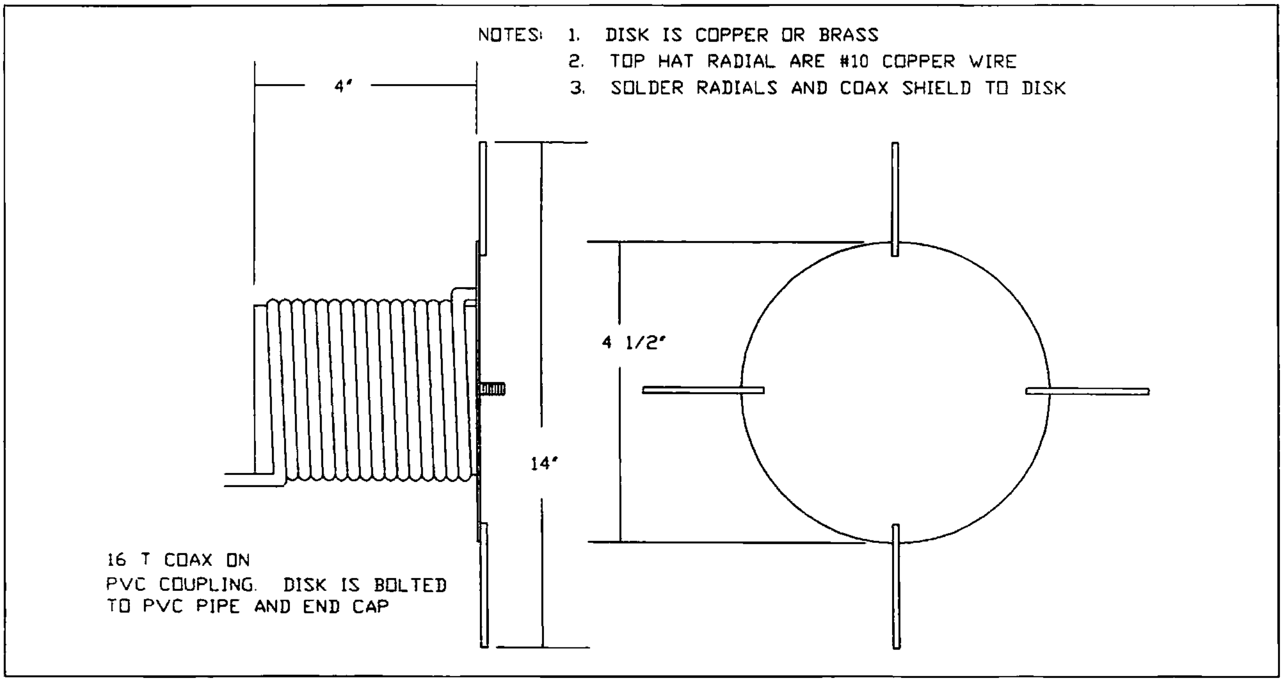


Figure 4. 20 meter resonator.

44-turn coil extends the lower frequency to 6845 kHz. It is possible to cover 40, 20, and 15 meters with this coil by tapping it to short more and more turns, but this compromises efficiency. A significant improvement in efficiency results from using shorter, unshorted coils to cover additional bands.

20 Meters

See Figure 4. The 20 meter resonator is constructed from a coil form made from a 1.5" PVC coupling sleeve and 1.5" PVC pipe cap. The cap and sleeve are connected with a short length of 1.5" PVC pipe and PVC cement. Cap and sleeve are pressed together for a zero clearance fit. Thirteen turns of coaxial cable is then close-wound onto this form and secured with epoxy. Almost any smaller diameter coax such as RG59, RG58, or RG62 can be used here. RG223 may offer superior performance with its silver-plated double shielding. Only the shield is used. Cut the center conductor flush at each end of the coil. A bolt is installed in the center of the pipe cap for the whip. This same bolt is used to secure the 5"-diameter brass disk that serves as a top hat. The top hat is required to bring this resonator down to the 20 meter band because the coil does not provide enough inductance to do the job alone. An additional three turns on the coil would eliminate the top hat, but I had better results using the top hat. The top hat also provides a convenient connection for the upper termination of the coil. The coax braid is passed through a hole in the disk and soldered.

Tuning

After the mast is mounted to the vehicle and the feedline has been routed and connected you are ready to tune the resonators. A grid dip meter is useful but not necessary. Start with the 75 meter resonator. With the transceiver tuned to 75 meters, adjust the taps on the resonator while listening for an increase in noise from the rig. There should be a dramatic increase in noise as you approach resonance. I experienced a difference of four S-units between resonant and non-resonant conditions. You will probably have to tune the rig across the band while experimenting with the taps to find the noise peak. When you have the resonator peaked for noise, use an SWR bridge to find the best tap on the matching coil for a 50-ohm match. I found my optimum match with five turns of matching coil shorted to ground. With 100 watts and the SWR meter set to maximum sensitivity, there was only a slight indication of movement from the meter pointer indicating an insignificant amount of reflected power. Experiments with a pencil drew 1/4"-long arcs of RF from the ends of the capacity hat under these conditions, indicating that power was indeed being transferred to the antenna.

A #47 pilot light bulb or equivalent can also be used to indicate current flow in the antenna. Attach test leads to the bulb. Connect one test lead to the ground connection at the base of the antenna. Connect the other test lead to the lower end of the resonator coil. Key down and *carefully* increase power output while on frequency at a suspected resonance point. There will be a significant increase in brightness as the transceiver is tuned through the resonance point. The test leads can be of equal length as actual location of the bulb is not critical. Total length of the test leads should approximate the distance between the electrical connections of the indicator to the mast to keep the slack in the wire to a minimum.

There are three logical ways to shift the resonance point. Moving the taps on the coil will cause the greatest shift. Adjusting the length of the whip in small increments will cause the smallest shift. Increasing the length or number of radial wires of the capacity hat will shift the point down in frequency; decreasing them will cause an upward shift. With so many ways of tuning it is possible to bring the resonance point very precisely to any frequency in the band. Once you determine the various points of resonance for each coil tap, you may want to make a chart for future reference. As long as the installation is not modified the results are consistently reproducible. A chart would allow frequency changes without the need for an SWR meter.

Tuning becomes less critical as frequency and bandwidth increase. Once you have the antenna working properly on 75 meters, additional adjustments to whip length become undesirable. Any further adjustments to the whip length to fine-tune the other bands will detune the system for the 75 meter resonator. Alternate means of tuning become desirable. On 40 meters, coil tapping is the simplest solution. If coil tapping is not desirable for whatever reason (i.e. inconvenient location on the coil), the addition of a small capacity hat will help fine-tune the system. The strategy here is to end up with a fixed whip length optimized for the lower frequency band. Resonance on the other bands becomes a function of resonator characteristics alone, allowing quick and easy band changes while preserving efficiency. Where used, all the top hats are an integral part of the resonator assemblies.

The input impedance of the system does change from band to band, but a low SWR can still be maintained with the 75 meter matching coil tap. The convenience of a permanent connection on the matching coil for all bands outweighs the minor decrease in efficiency resulting from a 0.5 change in SWR. I found no change in performance between an SWR of 1:1 and an SWR of 1.5:1. In fact, the only downside to running a 3:1 SWR is decreased power output from my solid-state transceiver. I can still communicate effectively at the higher SWR. Feedline losses appear to be near insignificant with a feedline length of only 15 feet and the antenna still radiates the power it receives.

After all the resonators were built, tuned and tested over a period of several weeks, I encapsulated them with polyester Fiberglas resin. This is a smelly, messy process but very effectively seals the coils. No shift in frequency or performance was observed after encapsulation. After the resin cured, I spray-painted all parts of the antenna flat black to improve the appearance of the installation. Take care to ensure that the paint is non-conductive. A flashy metal flake paint job will ensure a disaster instead of the inexpensive and effective HF mobile antenna system desired.

A Shortwave Converter for your Scanner

Build this easy gadget and listen in on HF.

by Steve Donnell WA1KYL

There are many ways of using a converter as a simple method for receiving HF broadcasts. Typically, the shortwaves (3-30 MHz) are converted down to the 540-1600 kHz band where a standard AM broadcast band receiver is used as a fixed or tunable IF. And while this conversion scheme can be considered cost effective, it is not without its problems. Things like limited tuning range, "feed-through" interference from local AM signals, the difficulty of accurate calibration, and even tuning images, can plague this classic design.

While the old AM Broadcast receiver hasn't completely disappeared from the scene, I chose to take a different approach by using a type of receiver that is becoming more and more common in homes and ham shacks, the VHF/UHF scanner. While scanners are typically used to receive FM modulated signals, many can also receive the VHF aircraft band (118-136 MHz AM), perfect as the "IF" for a shortwave converter. And as many newer designs for 2 meter transceivers can also receive AM signals in this range, the use of this band as an IF for a shortwave converter becomes even more logical.

Design

For the sake of simplicity, I designed my HF-to-VHF converter around the NE-602 IC (see Figure 1). The NE-602 IC is very popular with experimenters because of its ability to frequency-convert RF signals across a wide range of frequencies. Internally, the NE-602 consists of an oscillator that can be configured in a number of ways as an L/C or a crystal-tuned design. The oscillator feeds into an active mixer, which can accommodate signals of up to 100 MHz in frequency. Since most of the applications I have seen for the NE-602 were for RF conversions be-

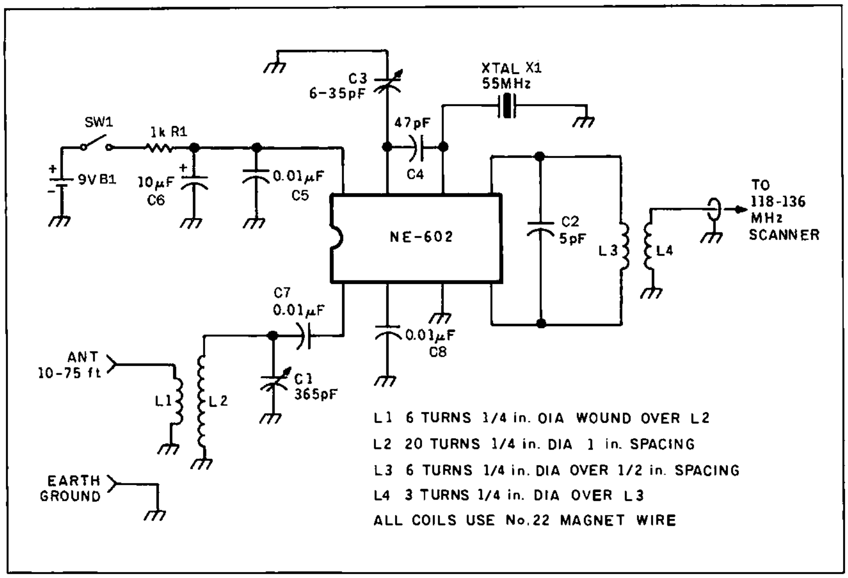


Figure 1. Schematic for the shortwave converter for your scanner.

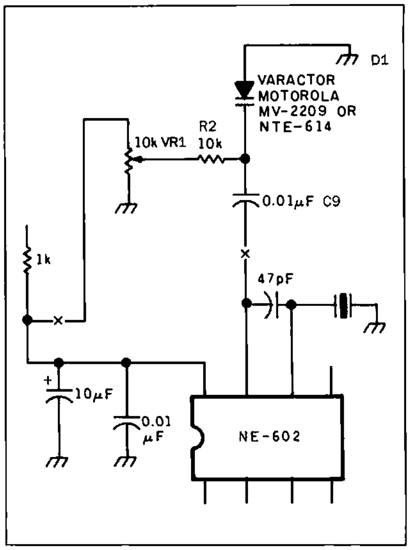


Figure 2. Schematic variation using a crystal tuning circuit with a varactor.

low 50 MHz, I wondered if I might be taxing the limits of the IC a bit at these higher VHF frequencies. But I soon discovered that these concerns were unwarranted.

RF signals from a receiving antenna are coupled into the converter by way of L1, and then to L2. L2 and C1, a 365 pF variable capacitor, function as a tuned "preselecter" to filter out noise and interference outside of the specific frequency band you want to receive. L1 and L2 are made with common #22 magnet wire, wound on a 1/4"-diameter plastic or wooden coil form. L1 is wound directly over L2. The desired receive frequencies are then coupled into the mixer of the NE-602 at pin 1.

For best stability and easiest calibration, I used a crystal oscillator design for the converter. Although somewhat better results might have been achieved using a crystal with an overtone frequency in the 110 MHz area, crystals in this range are not commonly found in the junk boxes of many experi-

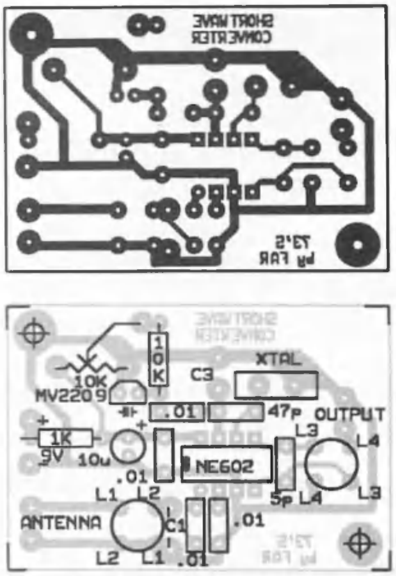


Figure 3. PCB layout and parts placement diagram.

Parts List

B1	9-volt battery
U1	NE-602 IC
D1	MV-2209 or NTE-614 varactor
L1	6 turns of #22 magnet wire wound over L2
L2	20 turns of #22 magnet wire 0.250" dia. 1" in length
L3	6 turns of #22 magnet wire 0.250" dia. 0.500" in length
L4	3 turns of #22 magnet wire wound over L3
C1	9.6-365 pF variable capacitor
C2	5 pF cpapcitor
C3	5-35 pF trimmer capacitor
C4	47 pF capacitor
C5	0.01 µF capacitor
C6	10 µF electrolytic capacitor
C7	0.01 µF capacitor
C8	0.01 µF capacitor
C9	0.01 µF capacitor
R1	1k ohm resistor
R2	10k ohm resistor
S1	SPST switch
VR1	10k ohm potentiometer

menters and may have been too close to the edge of the NE-602's oscillator to operate reliably. Thus, I chose to use an oscillator operating in the 50 MHz range. Crystals in this frequency range are commonly found in the junk boxes of most VHF circuit experimenters. I also figured that anyone with a programmable scanner might also have a couple of old VHF low-band scanner crystals around that could use a second life. Depending on what frequency range you want to receive, any old scanner crystal meant for receiving VHF channels in the 39-46 MHz range can be used. A scanner crystal used for receiving 45.30 MHz would actually have an oscillation frequency of 56.00 or 56.10 MHz (45.30 + 10.7 or 10.8 MHz), depending on what kind of scanner it was made to be used in, 10.7 and 10.8 MHz being the IF offset for the two most common varieties of scanners.

The best choice for a crystal would be one used to receive a frequency of 44.30 MHz in a scanner with a 10.7 MHz first IF. The crystal would actually be operating at 55 MHz (44.3 + 10.7 MHz). The second harmonic of the 55 MHz oscillation (110 MHz), provides the necessary local oscillator signal to convert the desired shortwave signals up to the 118-136 MHz band. The process of "upconverting" to a first IF that is a higher frequency than the original is not that unique. Receiver designs common to many HF receiver/transceivers currently on the market use a 70 MHz first IF.

A small-value trimmer or variable capacitor, C3, is needed to act as a "fine-tuning" control for the converter. Not only is this used for initial calibration, but it will also help in peak tuning of HF signals (some scanners use only 10 kHz tuning increments across the aircraft band, although most tune in 5 kHz increments). If the converter is housed in an enclosure of some kind you will want to mount C3 so it can be externally adjusted. If a chassis-mountable variable capacitor is not available for C3, a different approach would be to use a crystal tuning circuit with a varactor (see Figure 2), although this adds somewhat to the complexity of the circuit. I have often found that varactors can be more easily obtained from parts suppliers and off junk PC boards than mechanical capacitors. Depending on the varactor used, you may also need to add an extra 10 to 30 pF of fixed capacitance across it. By using the varactor, a common 10k potentiometer will become the fine-tuning control.

The mixer output is from pins 4 and 5 of the NE-602. Capacitor C2 and coil L3 function as a filter peak tuned in the middle of the aircraft band (approximately 128 MHz) and couple the desired converter signals into coil L4. L3 and L4 are wound from a short piece of #22 magnet wire, on a wooden or plastic coil form. L4 is wound directly over L3. Be sure that no direct DC "short" exists between L3 and L4. Because of the limited number of turns in L3 and L4, after the coils were wound and mounted to the circuit board I was able to remove the plastic dowel I used as the coil form for L3 and L4, and reuse it for winding L1 and L2 on. Connection of the converter to the scanner is made through a short length of coax cable, from the ground and L4 connection of the converter to the normal antenna connection of the scanner or other aircraft band receiver that is to be used as the converter's IF.

Construction and Alignment

There is nothing too critical about the parts layout and fabrication method for the converter circuit. In the construction of the prototype for this circuit I used an etched copper-clad board. But I mounted the parts directly to the copper side, without needing to drill through the board. I refer to this method as "pseudo-surface mount." An easier method would be to mail away for the prefabricated PC board. A drilled and etched PC board is available for $4 plus $1.50 S & H per order from Far Circuits, 18N640 Field Court, Dundee, IL 60118.

Alignment of the converter is easy. After verifying that the crystal oscillator was operating by listening for the fundamental or second harmonic with a monitor receiver, I then netted the frequency of the crystal on so as to produce as close as possible an integer value for its second harmonic frequency. This makes for the simplest conversion calculation from the HF frequency that you want to receive, and what you need to program into your scanner to hear it.

I then connected a longwire antenna to the input of the converter and connected the output to a portable scanner, to which I programmed in a frequency that was 10 MHz above the converter's local oscillator frequency. Capacitor C1 was adjusted to the clearest signal from the 10 MHz carrier of WWV. The converter's output circuit was peak-tuned by merely adjusting the spacing in the wire turns coil L3.

Although the measured sensitivity of the converter is at best about 3 µV, I have been able to easily receive stations like WWV and the BBC using the converter into my PRO-34 scanner, with little more than a two-foot-long test cable as my "antenna." A 20-to-75-foot-long wire or a tuned dipole will achieve better results.

I have not tried this, but a somewhat "deluxe" approach to housing this converter would be to mount it inside any one of the many shortwave antenna tuner/preselecters available commercially. This would eliminate the need to use the L1, L2 and C1 filter portion of the converter. This would also be likely to work better than the original filter. An even better approach would be to use a commercial tuner/preselecter that also includes a signal preamp. This would provide an active stage of amplification ahead of the converter's input for even better receive sensitivity.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Frequency Selective Filters for UHF and Up

A filter is a device or circuit that selectively discriminates against some frequencies, while favoring other frequencies. The cluster of favored frequencies is called the *passband* while the rejected frequencies are called the *stopband*. The filter operates by providing a large attenuation for stopband frequencies, and a minimum attenuation (ideally zero) for passband frequencies.

There are four general classes of filter that we will consider here: *low-pass, high-pass, bandpass and bandstop.*

The low-pass filter (LPF) characteristic (Figure 1A) shows that the filter passes frequencies from DC or near-DC to some *cut-off frequency* (F_c). The attenuation increases above the cut-off frequency until the maximum stopband value is reached. The filter *skirt* is the transition region between the passband and full stopband. The steepness of the skirt slope defines the filter quality.

The skirt slope is usually specified in terms of decibels of attenuation per octave (2:1 frequency change) or per decade (10:1 frequency change), i.e. dB/octave or dB/decade. If, for example, a low-pass filter is specified to exhibit a 10 dB/octave slope for a 200 MHz cut-off frequency, the attenuation at 400 MHz is 10 dB greater than the attenuation at 200 MHz, and at 800 MHz it is 20 dB greater than the 200 MHz value.

The cut-off frequency is defined as the frequency at which the response falls off -3 dB from its passband response. Because the passband response isn't smooth, however, the average attenuation value is used, and the cut-off frequency is found at the point where the attenuation figure increases three decibels (see "3 dB" point in Figure 1A).

The high-pass filter (HPF) has a response curve that is the inverse "mirror image" of the LPF response (see Figure 1B). The attenuation is very high below the cut-off frequency, and minimum above the cut-off frequency. As was true in the LPF case, the HPF has a skirt or transition region between the stopband and the passband.

The bandpass filter (BPF) is a combination of the LPF and HPF responses in which the respective cut-off frequencies are different (see Figure 1C). In the BPF there is a high attenuation stopband above and below the minimum attenuation passband region.

The passband bandwidth is defined as the frequency difference between the upper cut-off frequency (F_H) and lower cut-off frequency (F_L) on the response curve ([F_H - F_L in Figure 1C). This expression of bandwidth is usually called the "3-dB bandwidth" and is often abbreviated in data sheets and specifications as "BW3-dB."

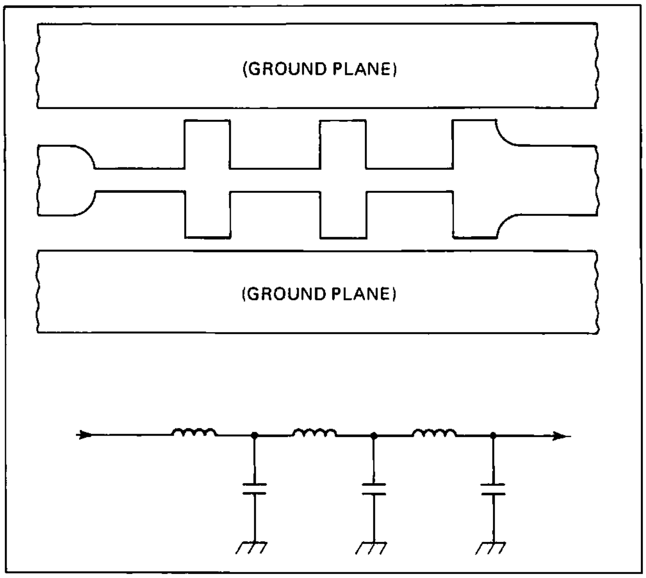


Figure 2. Printed circuit low-pass filter and equivalent circuit.

The upper and lower skirts define the sharpness of the cut-off characteristic between the passband and the two stopbands. This parameter is defined by the *shape factor,* which is the ratio of the 60 dB bandwidth to the 3-dB bandwidth. In terms of Figure 1C, the shape factor (SF) is:

$$S.F. = \frac{F_2 - F_1}{F_H - F_L} \quad (1)$$

or,

$$S.F. = \frac{BW_{60\ dB}}{BW_{3\ dB}} \quad (2)$$

The *figure of merit* or *quality factor* ("Q") of a bandpass filter is defined as the ratio of center frequency to the 3-dB bandwidth:

$$Q = \frac{F_C}{BW_{3\ dB}} \quad (3)$$

The Q and the shape factor must be considered in selecting or designing microwave filter circuits. The most obvious factor is the relative position of other-frequency signals compared with the center frequency of the filter. Also, the bandwidth must be sufficient to properly pass the spectrum of the expected signals without also being so wide that other signals and excess noise signals are also admitted. For fast rise-time signals (such as pulses or digital signals), a filter that is too narrow (i.e. too high Q) will "ring" in the same manner as in LC resonant "tank" circuits.

The passband of an ideal filter is perfectly "flat" (i.e. constant attenuation) for all frequencies between the cut-off frequencies. But in real filters this ideal condition is never met, so a certain *ripple factor* (see Figure 1C) exists within the passband. In high quality filters the passband ripple will be on the order of 0.1 dB to 0.5 dB, although in some cases a larger ripple (e.g. 1 dB) factor will be acceptable.

The *insertion loss* of a filter is the attenuation of signals inside the passband. Ideally, the insertion loss is zero, but that is not achievable. In most designs, the better the shape factor, or the higher the Q, the worse the insertion loss. This phenomenon is due to the fact that such filters usually have more elements or "poles" than lesser types, so therefore show greater in-band loss. Many circuit designers opt for a pre-filter or post-filter amplifier to make up for insertion loss.

The bandstop filter (BSP) is the inverse of the bandpass filter. The attenuation is greatest between the cut-off frequencies (see Figure 1D). At frequencies above and below the stopband signals are passed with minimal "insertion loss" attenuation. The purpose of a

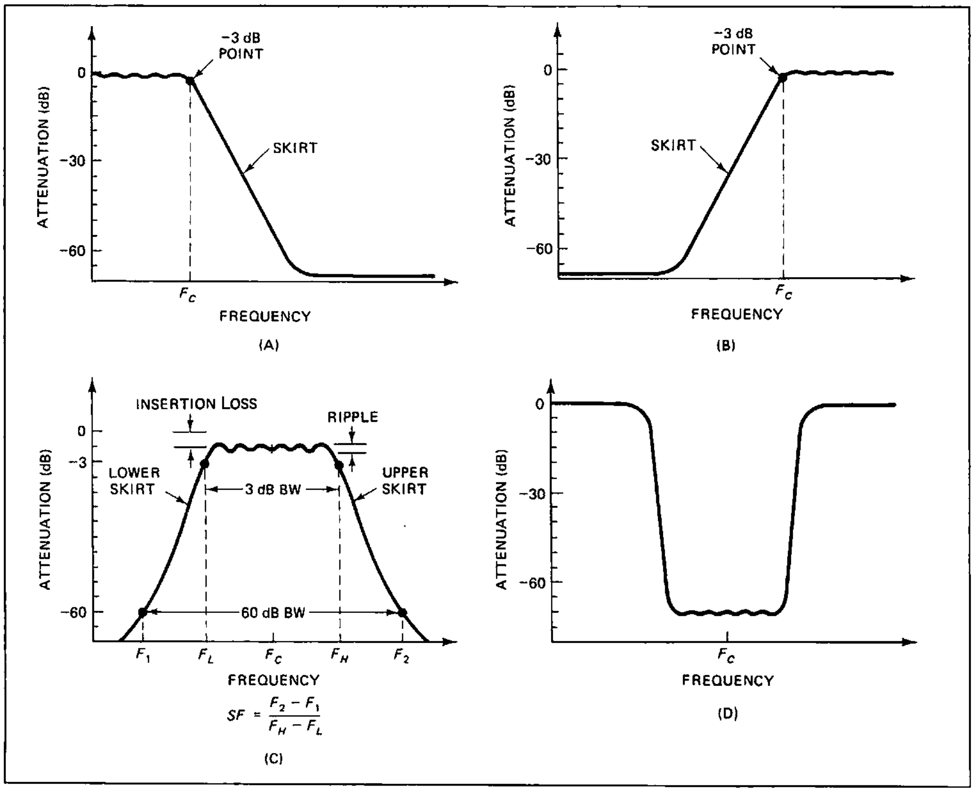


Figure 1. Filter frequency response characteristics.

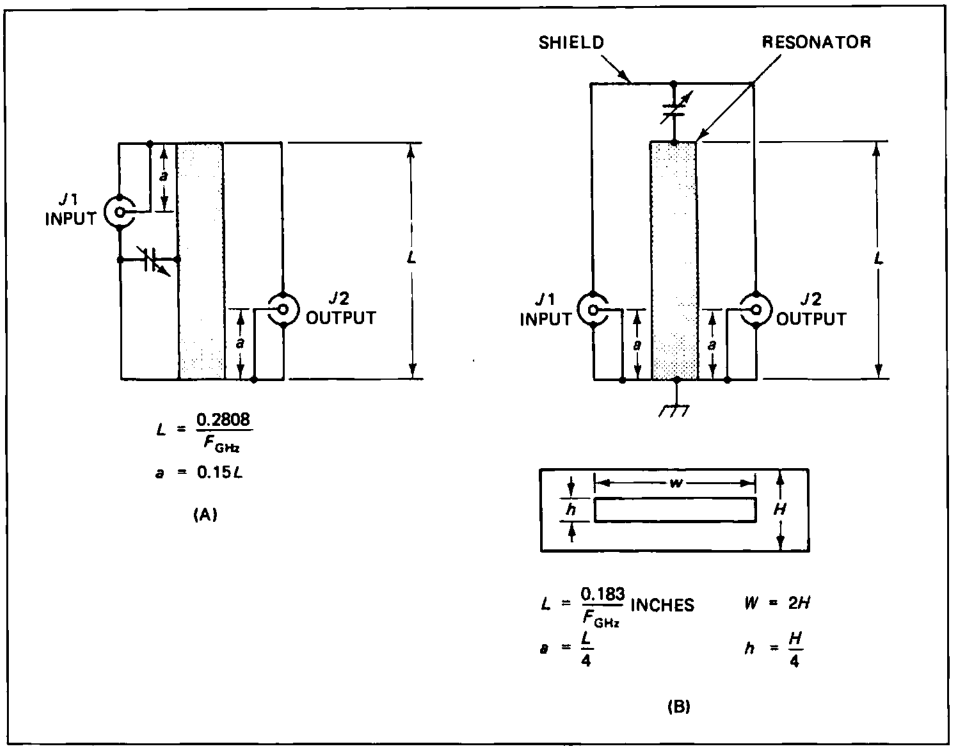


Figure 3. Stripline filters.

bandstop filter is to remove offending signals. An example is in communications systems where transmitters and receivers on two different frequencies are co-located at the same site. A receiver on frequency F1 will have a front-end bandstop filter on frequency F2, i.e. on the frequency of the co-located transmitter.

Typical UHF/Microwave Filters

At frequencies lower than microwave bands filters are often designed using lumped inductance and capacitance (L and C) components. In the microwave bands implementation of filters is through printed circuit stripline or (in UHF and low microwave bands) chip components. Figure 2 shows a microwave stripline implementation of a low-pass filter (HPF, BPF and BSP designs use the same methods but with different layouts).

As microwave frequencies increase the dimensions of the stripline components get smaller, eventually becoming too small to either carry required load currents or to be easily built using ordinary printed circuit techniques. But stripline width is a function of system impedance as well as frequency. As a result, microwave filter designers often design a filter for a lower input and/or output impedance than is required by the system, and then provide impedance matching networks to renormalize the circuit. For example, in a 50-ohm system the filter may be designed for 20-ohm termination impedances, with a 50:20-ohm impedance transformation provided at the input and output terminals. The resultant filter will have wider (more easily built) stripline tracks.

Two forms of resonant stripline bandpass filter are shown in Figure 3. The half-wavelength version is shown in Figure 3A, and the quarter-wavelength version in Figure 3B. This is a form of transmission line filter, and is usually built inside of a shielded container. At one time, one would cut metal strips (see older editions of *The ARRL Radio Amateur's Handbook* for examples) for the resonator (shaded area), but today an appropriate section of printed circuit board stripline can be substituted.

Another form of stripline filler is the interdigial design shown in Figure 4. This type of filter consists of a series of quarter-wavelength stripline transmission line segments. This sort of filter can be used well into the microwave region and are well suited to MMIC and hybrid circuit designs.

Figure 5 shows several forms of waveguide frequency selective filters. The cut-off frequency of waveguide is a function of crossectional dimensions. Similarly, inductive and capactive circuit action is found through the use of restrictive "irises" in a segment of waveguide. In Figure 5A we see the stepped or staircase bandpass filter. In this design, critically dimensioned steps are machined into the internal surfaces of a section of waveguide.

A cavity-type series resonant bandpass filter is shown in Figure 3B. Using a re-entrant resonant cavity, this filter allows passage of signals with a frequency around the resonant frequency. A parallel resonant cavity bandpass filter is shown in Figure 3C. This particular version is tunable by virtue of the volume-changing tuning disk inside of the cavity.

Conclusion

Filter circuits for VHF, UHF and our lower microwave bands need not be too complex to be effective. In some cases, filter elements can be purchased. Digi-Key (POB 677, Thief River Falls, MN) sells Toko helical resonators for VHF/UHF bands. Also, the advertisers in this magazine are sources of some forms of filter elements and parts. Finally, you can build them yourself.

I can be contacted at P.O. Box 1099, Falls Church, VA.

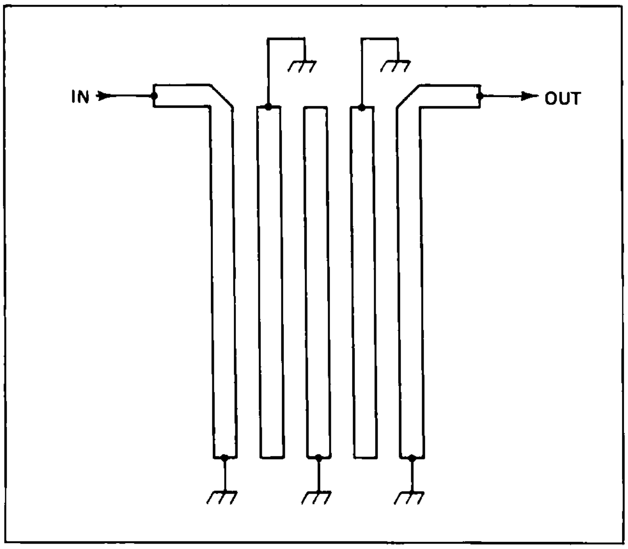


Figure 4. Inter-digital filter.

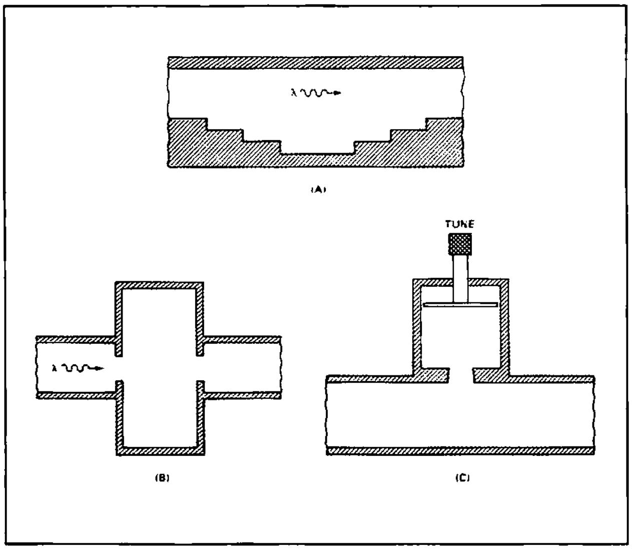


Figure 5. Microwave filters.

RTTY LOOP

Number 13 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

More from the E-mail Bag

If nothing else, many of you have been keeping my online mailbox full with E-mail on the various services on a regular basis. Let's keep looking at what tickles your fancy.

Success with HamComm Software

Luis Orozco N5UHB, tells us, via Internet, that he is 17 years old and about to start his last semester in high school. He lived in Las Cruces, New Mexico, from 1991-1994, and is now living in Monterrey, Mexico. He hopes to get his Mexican ham license soon, having been born in Mexico, living in Monterrey most of his life.

He passes along the following comments, from an admitted beginner in RTTY:

"I first started in RTTY when I got ahold of an early version of HamComm. I gathered the parts and built the little op amp interface for it, and I hooked it up to my HF rig to see what happened. Well, to my surprise, there I was, copying RTTY, and best of all, I hadn't spent a penny! I never got around to building any interface for transmitting, so I just listened for a long time. A few months ago, I was listening to a QSO, and I really wanted to join in, but didn't have any way to do it. Well, since HamComm will generate the RTTY tone in the PC speaker, I just put the rig on sideband and keyed the microphone, and made the PC send a 'de N5UHB N5UHB N5UHB k.' It worked, and one of the other stations came back to me. It was a good QSO. I'm not on the air right now, but as soon as I get into HF again I'll have to hook up the PC-speaker audio to the microphone audio input through a transformer. By the way, later I got the new version of HamComm, which also works in AMTOR. In my opinion, HamComm is one of the few shareware programs that's worth the 'registration fee' (even if you gotta send it all the way to Europe!).

That's about it. I just thought you'd like to know N5UHB's way to get into RTTY for the least amount of cash. I'm sure there are lots of people out there who can't afford a modem or multimode controller but would still like to play RTTY."

Luis, I appreciate your observations, as one of the most common questions I get is a request for a suggestion for starting software. Of course, HamComm is one of the featured programs in the RTTY Loop Software series. Version 2.2 of the program is on Disk #5, and any updates received will be included on future disks as well.

RTTY for the Mac

Another E-mail correspondent is Paulo Teixeira N3MGA, who is responding to the quest of Ralph Howard WD6BGN for an interfaceless RTTY program for a Macintosh computer:

"Bad news, such a thing does not exist as of yet. I would recommend that he, at this point, get Hostmaster for his KAM, which is available directly from Kantronics. That program supports RTTY as well as other digital modes for HF and VHF.

As soon as I got my first Mac and a modem, I hit the major online services searching for software that would help me with the hobby, namely with packet. Not much was found, except for an excellent effort at AOL on their Ham Radio/Mac section. I downloaded most of what I found and over time I got a good collection of files. My next step was the Internet, where I gathered more programs and met some of the developers.

Nowadays, I have decided to share my findings through a small one-line BBS I run from home, which is on 24 hours a day and is available free of charge to anyone. The name is Gallery's BBS and it's at (202) 333-0407. Files sections consist mainly of Ham radio shareware for the Mac and other general files for that platform. I normally scan between two to four Internet FTP sites on a weekly basis in search of the latest software, which pretty much sums up that if my BBS doesn't have it, it is not available.

I hope this information can help some of your readers and, again, anyone is welcome to log on and download whatever they like."

Well, Paulo, since I do not have a Mac, it has seemed rather clumsy for me to offer Mac software, which is, as you note, available at various places online, as part of the PC-based "RTTY Loop" collection. I therefore welcome your support for the Mac. If my guess is correct, readers of this column should be patient, the busy signal on your BBS should be a constant finding for a while.

Using the CoCo for RTTY

Since we've heard from a PC user and a Mac user, it seems only fair to give the user of another system his day in the sun. Stephen Coker VA3LS, tells us of his operations with the Yaesu YR-901 CW/RTTY Code Reader and the YK-901 keyboard for RTTY. He normally uses it on HF, but did try 2 meter RTTY once and worked direct over 80 miles with only 20 watts! Computerwise, he has a Radio Shack CoCo3 color computer, as well as an IBM in the shack. He hopes to try the CoCo out on RTTY, if he can find software for it.

Well, Stephen, if you will look around, there are a few programs online for the CoCo. One site available to Internet users is the CoCo SIG on Delphi. You can either telnet to Delphi, or take advantage of the bargain rates detailed here a few months ago to join the net directly. Good luck, and let me hear how you are making out.

"RTTY Loop" Software

In the comments on HamComm, I referred to the "RTTY Loop" Software Series. For those of you who may have come in late, and Wayne tells me that there are lots of new subscribers, I have eight collections of programs, mostly PC compatible, of use to RTTY/packet hams. Disk #3 is unique, as it is a collection of DOS/Windows utilities for archiving and viewing programs. The others are various RTTY, packet, AMTOR, CW, and utility programs. Send me a self-addressed, stamped envelope, to the above address, or E-mail to me on CompuServe (75036,2501), Delphi (MarcWA3AJR), America Online (MarcWA3AJR), or use the AOL Internet access at MarcWA3AJR@aol.com, and I will be happy to send you a copy of the list. The programs may be yours by sending me sufficient media, a stamped return disk mailer, and $2 per disk to be filled, to the above address.

More than requests for the disks, though, I look forward to your comments, questions, and suggestions. In the pipeline is a review of an inexpensive way to get onto VHF packet, and maybe a look at some other equipment as well. While things are still fluid at this time, I look forward to other exciting developments in the coming months' "RTTY Loop."

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

The Dragon Slayer

All right. I'll admit it. There are times when the dragon wins, even when running QRP. So, what do you do? Well, I could run over to Randy KD8JN's QTH and tire up Mr. Heath SB220, then dump the output of his Argonaut II into the amp and really chase the DX. However, Randy is usually busy trying to talk his wife into letting him go to the next hamfest. I really don't want to get involved with that program.

So, I did the next best thing—I designed my own dragon slayer QRP amplifier. That sounds like a double standard to me! But since this is April, what better time to get one more project under your belt?

The circuit is really simple. This amplifier will produce over 1 kW at keydown with less than 1 watt of drive. Since I work 40 meter CW most of the time, there is no band switch to mess with. You can put the amplifier on any band you wish by changing out the filter components used in the output filter. Since we are working with more power than most of us are used to, the output filter may be a hard part to reproduce. Follow the details in the schematic for the filter. I used 3/4" copper pipe filled with an inert gas. Don't use helium, though—it causes the CW note to sound like a Tweety bird in a blender. Nitrogen is the preferred gas for the filter.

Drive from the exciter is fed into the base of Q1 via the matching transformer. This provides a 50-ohm load for the driver and matches the low impedance of the base of the transistor. This amplifier uses four transistors, one for every 10 meters of wavelength. Thus, an amplifier designed for 40 meters will require four output transistors.

The transistor I decided on is the very popular 2N2222a. However, be sure you use the metal case device and not the TO-92 plastic style. I'll explain why later on.

I don't operate SSB, so the amplifier is biased for class RCS operation. Thus, no current flows until drive is applied to the amplifier. If you want, a small bias voltage could be placed on the base of each output transistor, but keep in mind you'll need to balance the collector current of each transistor. A 105 amp/hour car battery would be an ideal bias supply.

Instead of using a special regulator just for the amplifier's bias, we can employ an old trick. The forward voltage drop across an LED will provide a very stable 1.5 volts. However, that's not going to be enough bias for good class RAS operation, so instead of an LED we'll use a Dark Emitting Diode or DED. A DED will supply 5.6 volts when forward biased. A 48-ohm 250-watt carbon resistor should be used to limit current through the DED.

To generate a full kW of output means we have to supply our amplifier with lots of input power. For shack use, a Lincoln RM-63 welder is ideal. Be sure you operate the Lincoln on a 220-volt AC buss. If possible, use a 440-volt AC input to keep the line voltage from dropping during keydown.

Not to leave us QRPers out in left field during Field Day, you can also use a Miller Blue Star 2E portable welder/generator. I like the Miller unit because it has an auto idle feature to slow the engine down during standby.

In either case, feeding all this power to the amplifier requires a bit more care than usual. I prefer to use four-ought weld cable. It's flexible and easy to route from the power source to the amplifier. I should have used fuses in the DC lead, but the voltage drop caused me lots of headaches. So, I depend on the power company's main breaker at the pole in case of trouble.

Nothing in life is perfect and this amplifier is no exception to the rule. The amplifier is about 60 percent efficient. The rest of the energy is turned into heat—heat that must be removed. I worked on a water-cooled system, but tossed it out as being too complex. I went for a forced-air cooling system. Be advised: The forced air cooling may not be enough to keep the amplifier from melting if you bias the amp for class RAS operation.

The Heat Sinks

The heart of the cooling system lies in the one-foot-by-one-foot extruded aluminum heat sink. There's one heat sink for each transistor. Now you can see why I specified the metal case 2N2222 transistor. The metal case of the transistor is bonded to the aluminum heat sink by using "solder it" soldering compound. Each output transistor is mounted smack dab in the middle of each heat sink. Because the case of the transistor is internally connected to the collector, the heat sink also provides an excellent method of routing the DC operating voltage to the amplifier.

The downside of this idea? All four heat sinks are now hot with DC and RF. I used Teflon to insulate the heat sinks from the outside environment. Keep the kids, cat, dog and other untedar mammals away from the amplifier. An RF burn from this guy would be rather painful!

There are also eight 220-volt muffin fans attached to the heat sinks. One fan blows on one end and another sucks the air out. Thus, there are two fans for each heat sink. There are four heat sinks, for a total of eight fans. This "blow/suck" cooling seems to work quite well indeed. There is one slight drawback: With all those fans running, the noise level can be quite high. Ear protection would be a wise idea.

With the amplifier thus insulated, during keydown in a dark room the entire assembly takes on a hazy pink glow. As a side benefit, the amplifier now keeps the shack full of ozone. My shack has the fresh springtime thunderstorm smell! It's also a great way to light cigars!

Construction is simple. There's no PC board—the copper could not handle the current. Instead, I use 1/2" copper tubing pounded flat to wire the amplifier. You won't be able to use your standard soldering iron here. The copper tubing draws the heat away too fast to allow a good solder joint. So, I used a propane-powered torch. Building the amplifier used up about 20 pounds of propane. Keep the lead short and direct. Don't forget to bypass the welder at the input to the amplifier with 0.001 doorknob capacitors.

Putting the amplifier to work is easy. Just connect your antenna to the output RCA jack and connect your Argo up. Since this is a single-band amplifier, all you need to do is key down and start making contacts. Under normal operating conditions there will be some smoke as the weld cable heats up. This is normal.

I hope you enjoyed this project. It sure is a lot of fun to be on the top of the pile now and then. So, pick up some propane, a box of cigars and have fun. Projects like this only come once a year—*usually around the first of April.*

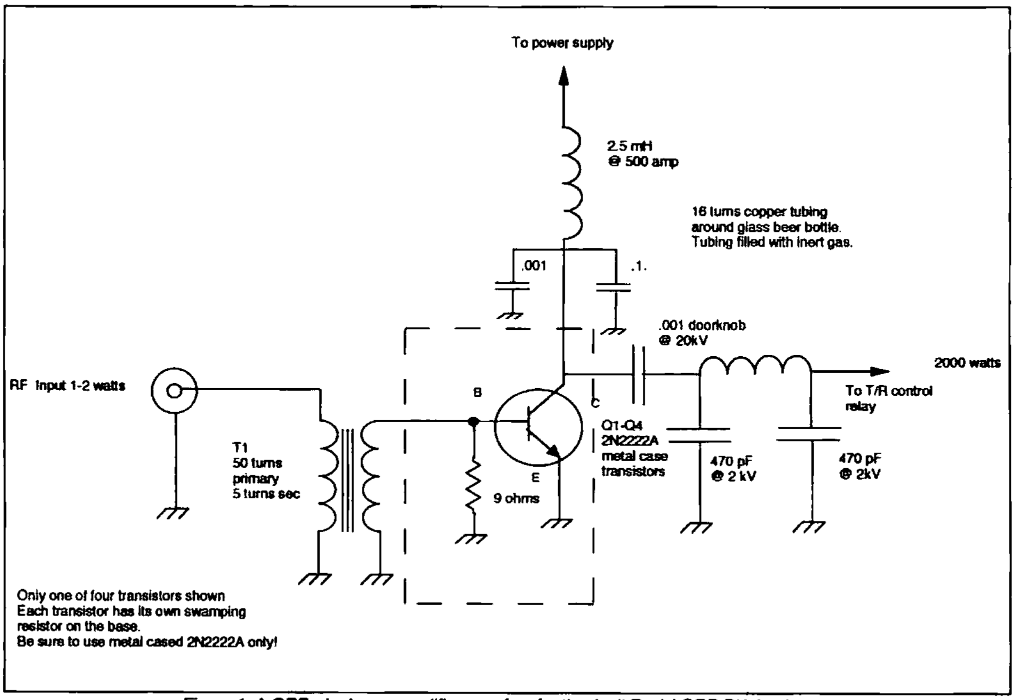


Figure 1. A QRPer's dream amplifier—perfect for the April Fools' QRP DX Jamboree.

Number 15 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton CA 92633

A Good Doppler Gets Better

Chopsticks, silverware, plasticware, or your fingers? You can eat lunch with any of them. Your choice depends on where you are and what you're eating. Similarly, there are many methods for tracking a VHF signal, and more than one will work. Such factors as simplicity, cost, stealthiness, sensitivity, response time, and the nature of the signal come into play as you make your equipment decision.

Doppler units are the "weapons of choice" among radio direction finding (RDF) enthusiasts for mobile hidden transmitter hunting (sometimes called T-hunting or foxhunting) in many parts of the country. They indicate the direction of incoming VHF signals on a circular ring of light-emitting diodes or a digital display. A doppler set updates bearings almost instantaneously, so even short carrier bursts can be tracked.

A doppler installation can be done quickly on just about any vehicle. It has a much lower profile than an RDF yagi or quad setup. The multi-element antenna assembly replaces your mobile whip. The control unit extracts direction information from a tone that the antenna set adds to the audio output of your VHF-FM transceiver or scanner.

Excellent commercial doppler models are available for several hundred dollars, but you can build your own at a fraction of the cost. Today's most popular do-it-yourself doppler was originated by Chuck Tavaris N4FQ of Roanoke, Virginia. Tom Curlee WB6UZZ and I made some enhancements and documented the design. We named it the Roanoke Doppler in honor of N4FQ's T-hunting grounds.

Complete plans for the Roanoke Doppler are in *Transmitter Hunting—Radio Direction Finding Simplified* (TAB/McGraw-Hill #2701), available from Uncle Wayne's Bookshelf. One chapter in this book thoroughly discusses the theory of RDF using the doppler principle and gives much more information about techniques, advantages and disadvantages than space here allows.

Since publication, several hams have made circuit boards and kits available for the Roanoke Doppler controls and display. Presently, there are two board suppliers, listed in the sidebar. They are not affiliated with the book's authors or publisher, so contact them directly for information on their products.

Antenna Design Secrets

The doppler effect is created on an incoming signal by moving a vertical receiving antenna in a horizontal circle so rapidly that the signal's frequency appears to shift. Relative phase of the frequency-modulation tone produced by the doppler effect gives direction of arrival of the signal. For a useful FM deviation level of the doppler tone on typical VHF/UHF bands, the antenna must move at about 500 revolutions per second (30,000 RPM).

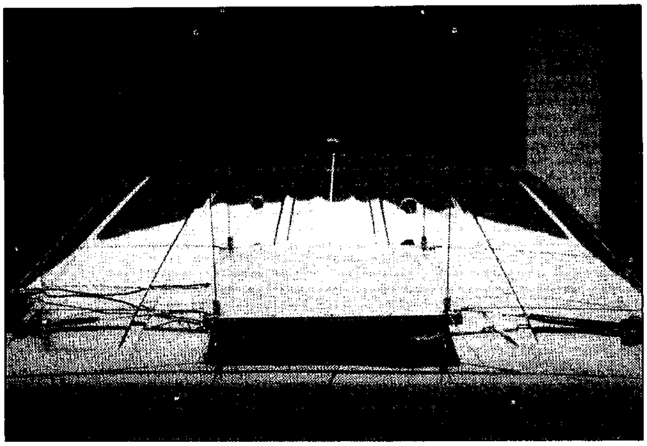


Photo A. The Roanoke Doppler antenna array has four quarter-wavelength whips on a 20 X 20 inch metal plate with eight radials to provide a ground plane under each whip.

This rate is impractical mechanically (to say the least), so early doppler experimenters tried putting 16 or 32 vertical dipoles in a circle and connecting them one at a time to the receiver input at the 500 rotations per second rate. This would be just as difficult to achieve mechanically, but it can easily be done electrically with special RF positive-intrinsic-negative (PIN) diodes.

The first big "pseudo-rotating" arrays worked just fine, so experimenters tried to find out if fewer elements would work, too. They discovered that switched signals from four dipoles give the signal's direction data just fine if very narrow audio filtering (2 Hz or less bandwidth) is used in the tone processing circuits to recreate the sinusoidal doppler FM modulation of a single rotating dipole.

The Roanoke Doppler achieves this narrow bandwidth with a switched-capacitor bandpass filter. It is locked to the unit's master clock so that the filter's center frequency tracks the antenna rotation rate and thus the induced doppler tone. Experimenters also found that quarter-wavelength whips over a common ground plane make a good doppler array for mobile use.

There are some pitfalls to designing a multi-whip mobile doppler array. To simulate the effect of a single whip moving in a perfect circular track on the vehicle roof, each whip must be connected to the receiver for precisely one quarter of the total time and the switching sequence must be in the proper order of pseudo-rotation. The whip that is ON at a given instant must have low loss to the receiver input, while the three others must appear to be non-existent. As Tom and I discovered while optimizing the Roanoke Doppler array, OFF whips should not be electrically connected to the ground plane because that makes them parasitic elements that adversely affect the directivity of the ON whip.

You might think that each whip's directivity is not important because only phase information is being extracted from the doppler signal, not amplitude. But directional antennas, especially multi-element phased arrays, exhibit variations in phase output versus azimuth direction. It's a safe bet that the more amplitude directivity in an array, the more phase change versus direction it will have as well. Ideally, there should be no phase change versus signal direction for any single whip in the doppler array. Phase changes in the array output should be caused only by the pseudo-rotation.

To evaluate the effects that termina-

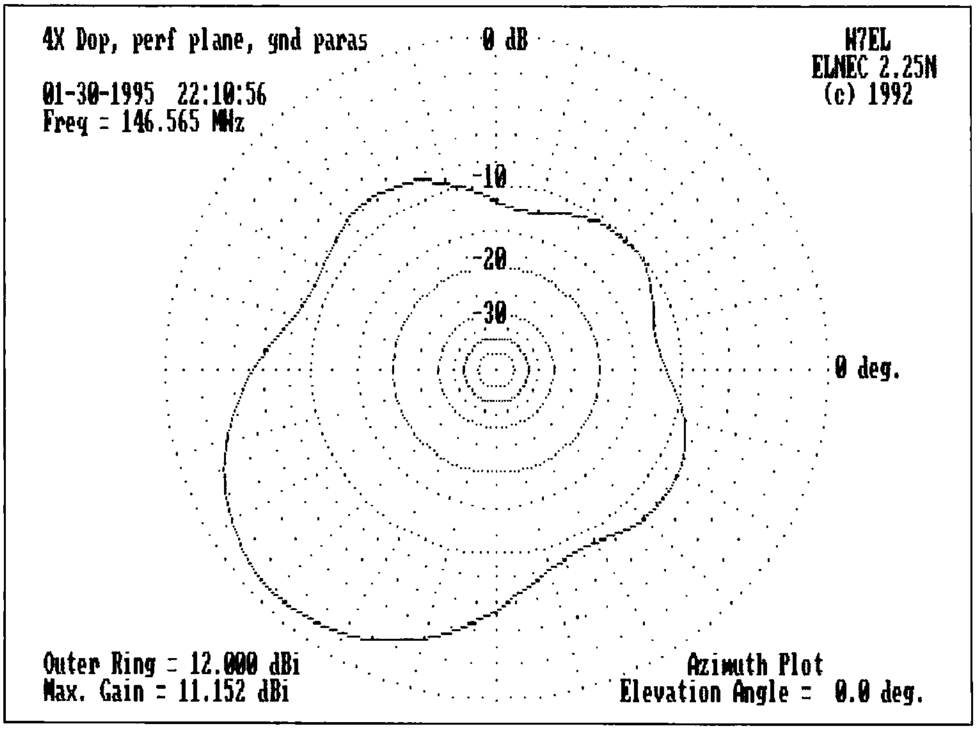


Figure 1. ELNEC azimuth pattern plot of a four-whip doppler array with three whips grounded and one connected to the feedline. The large lobe is in the direction of the active whip, which is in the lower left of the array.

tion of OFF whips can have on the active whip, I analyzed the Roanoke Doppler 2 meter array using ELNEC, an antenna modeling computer program for the PC. ELNEC produces azimuth and elevation radiation patterns for VHF and UHF single-element antennas, parasitic arrays, and phased arrays. For simplicity, I assumed four quarter-wavelength elements in an 18-inch square pattern over a perfect ground plane at an instant in time.

When OFF whips are grounded, the array is very directional, as Figure 1 shows. One whip in the clear would have 5.14 dB gain with respect to an isotropic radiator (dBi). Gain of this array varies from 11.15 dBi in the direction of the driven whip to 0.5 dBi in two other directions.

ELNEC does not plot phase versus azimuth. Creator Roy Lewallen W7EL told me that until I called him, no one had asked for this feature. Exact phase variation can be calculated, but the extra effort would not be worthwhile. The object of the analysis was to minimize the effect, not quantify it. It is clear that gain variation in excess of 10 dB produces an unacceptable amount of phase variation. On the other hand, if the OFF whip feedpoints are open-circuited (Figure 2), gain variation is only 1.1 dB, which is good.

Experience has proven the validity of this analysis. I have tested two four-whip doppler antenna designs (one commercial and one home-brew) that grounded the OFF whips with shunt PIN diodes at the antenna bases. In both cases, it was very difficult to get reliable bearings when the vehicle was moving on city streets. Performance improved markedly when the sets were modified to open-circuit the whip feedpoints when off.

The Roanoke Doppler antenna uses

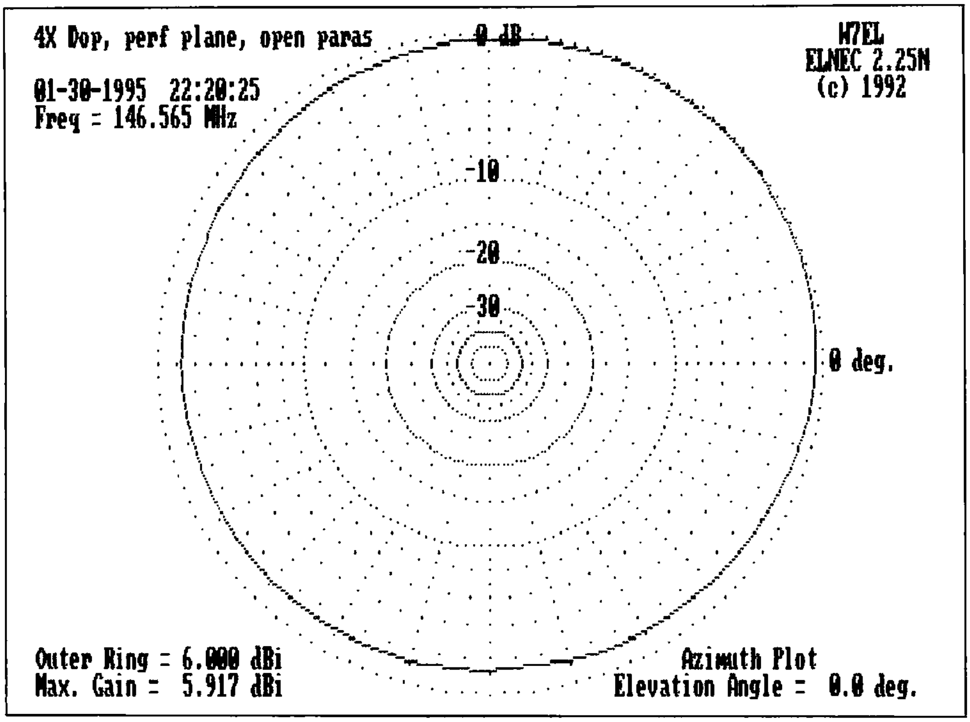


Figure 2. The undesirable lobe disappears and a nearly perfect circular pattern with no phase anomolies is achieved when the switched-off whips are open-circuited to minimize parasitic effects.

PIN diodes to short the exact center of half-wavelength coax lines going from the common point to the feed point of each whip. Since an electrical quarter-wavelength of coax acts as an impedance transformer, an apparent open circuit exists at both the common point and feedpoint when the diode conducts.

Some RDFers have suggested that terminating OFF whips with 50 ohms would minimize reradiation and give the best pattern. However, ELNEC analysis showed that this is not the case. Gain variation would be almost 5 dB with loaded OFF whips, not nearly as good as open-circuiting them.

A New Roanoke Switcher

The Roanoke Doppler antenna design in the book works well on strong 2 meter signals. I have used it on over a hundred T-hunts. But it has room for improvement. The requirement for exact half-wavelengths of coax limits an array to a narrow frequency range (typically 5%). Furthermore, readers who have tried to scale the array for higher frequencies (such as the 70 centimeter band) have had disappointing results.

Last summer, I designed an improved switching system for the Roanoke Doppler and invited several T-hunters to build and test it. The new design (Figure 3) features series PIN diodes at each end of the coax lines to the four whips. This means that the coaxes can be any reasonable length, so long as the four lengths are equal. Coax lengths no longer limit the bandwidth of the array, so it is possible to use one array to cover tens of megahertz, limited only by array spacing and values of inductors and capacitors in the switcher. I have not tested the limits of its frequency range yet, but the new 2 meter array gives bearings on the 162.55 MHz weather station that are just as good as bearings on 146 MHz.

In the new Roanoke Doppler antenna switcher, PIN diodes receive more current drive in the ON state (7.5 mA), to reduce loss and improve overall sensitivity. Diodes are reverse-biased when OFF to provide better isolation. In my tests, the new switcher made the Roanoke Doppler noticeably more sensitive. It gives bearings on weak signals that would have been masked by switching noise with the original antenna.

It's not hard to upgrade your present Roanoke Doppler switcher to use the new circuit. Most of the existing chokes and capacitors are unaffected. Just delete half of each two-section RG-174 coax line, put PIN diodes at the end of each remaining line, add resistors at the antenna bases, then install L105 and C109. Note that the RG-174 lines to each whip are soldered to the plane at both ends, but the shield of the coax to the receiver connects to the plane through C109.

Changing from shunt to series RF diodes requires minor modifications in the control unit. The fifth wire in the control cable becomes a positive voltage source instead of a return connection. D13, D14, C26, and R38 set the potential on the counterpoise plane and radials at two diode drops below +5V (approximately +3.5V) instead of vehicle DC ground potential. If you fabricated the antenna unit per Photo A, using a copper-clad sheet on a wood base mounted with suction cups to insulate it from the car, DC on the sheet is not a problem.

I use Motorola MPN3401 PIN diodes at D101-D108. They are available by mail from Debco Electronics. Debco has no minimum order requirement. Your local parts house may carry the ECG-555 or NTE-555; both are good substitutes.

Miniature (quarter-watt resistor-sized) RF chokes typically have iron cores. The distributed capacitance of these chokes gives them self-resonant frequencies in the 75 MHz range. This is below 2 meters, so these chokes can act like capacitors instead of inductors there. Non-ferrous core chokes have self-resonant frequencies near 200 MHz, so be sure to use them in the switcher instead of iron-core chokes. For L101-L105, I recommend J. W. Miller #4602 (1.0 μH) or #4604 (1.5 μH), available at many local distributors. These chokes are about the size of a 1-watt resistor.

You can easily make your own 1 μH chokes on 1" lengths of 3/16" diameter polystyrene rods. Wind 24 turns of AWG 26 enameled wire on the rod in a single layer, close-spaced. With the wire held in place with a bit of tape, cover the winding lightly with Q-Dope, a liquid polystyrene coating made by GC Electronics. Q-Dope is available at electronics parts stores. I use it outside to keep the shack fume-free. After the coating hardens, strip enamel from ends of the leads and install the choke.

Be sure to delete the 680-ohm drive resistors (R24-R27) in the control unit, replacing them with jumper wires. They are no longer needed because this function is performed by R101-R104 in the antenna unit. If your control unit has an A-suffix part at U5 (such as CD4049A or MC14049B), replace it with a B-suffix part to get adequate current drive.

Upcoming installments of "Homing In" will go into more detail on the wideband performance of the new switching circuit. I will describe a UHF version that works great, according to a reader who tested it, and I'll explain how to space the whips and pick components to cover your favorite frequency range.

From the Mail Room

Thanks to all of you who have sent me your RDF news and inquiries over the past 75 months. I have tried to respond personally to every letter and E-mail message in a reasonable time, but in a few cases, I couldn't because the writing was illegible. If you have

been waiting for a reply for over a month, try again. Your E-mail may have been lost in cyberspace or I may not have been able to decipher your address.

Unlike Congresspeople, *73* authors don't have franking privileges. We buy our own stamps and stationery, so all of us appreciate the courtesy of a self-addressed stamped envelope (SASE) for the reply. I put letters with SASEs at the top of the pile, for earliest response.

For me, electronic mail is faster and better than postal mail. To better cope with the increasing E-mail volume, I have changed the Internet gateway for this column to America Online. My address is now Homingln@aol.com. I will be closing out the old Portal address soon, but will remain on CompuServe (75236,2165).

The *73* typesetting computer has a mind of its own when it comes to putting hyphens at the end of text lines. In the December 1994 and February 1995 issues, it added them to a couple of Internet addresses, causing frustration to some readers. No matter how these paragraphs get formatted this month, remember that there is one dash in fox-list@netcom.com (the Internet RDF mailing list), but no dashes in listserv@netcom.com (the subscription address for fox-list) or in my Internet address.

Resources Mentioned in this Article

Roanoke Doppler boards:
Tom Lewis AB5CK
6721 Rolling Hills Dr.
North Richland Hills TX 76180

Marty Mitchell N6ZAV
340 Otero
Newport Beach CA 92660

ELNEC antenna analysis program:
Roy Lewallen W7EL
P.O. Box 6658
Beaverton OR 97007

PIN diodes and other components:
Debco Electronics
4025 Edwards Road
Cincinnati OH 45209
(513) 531-4499

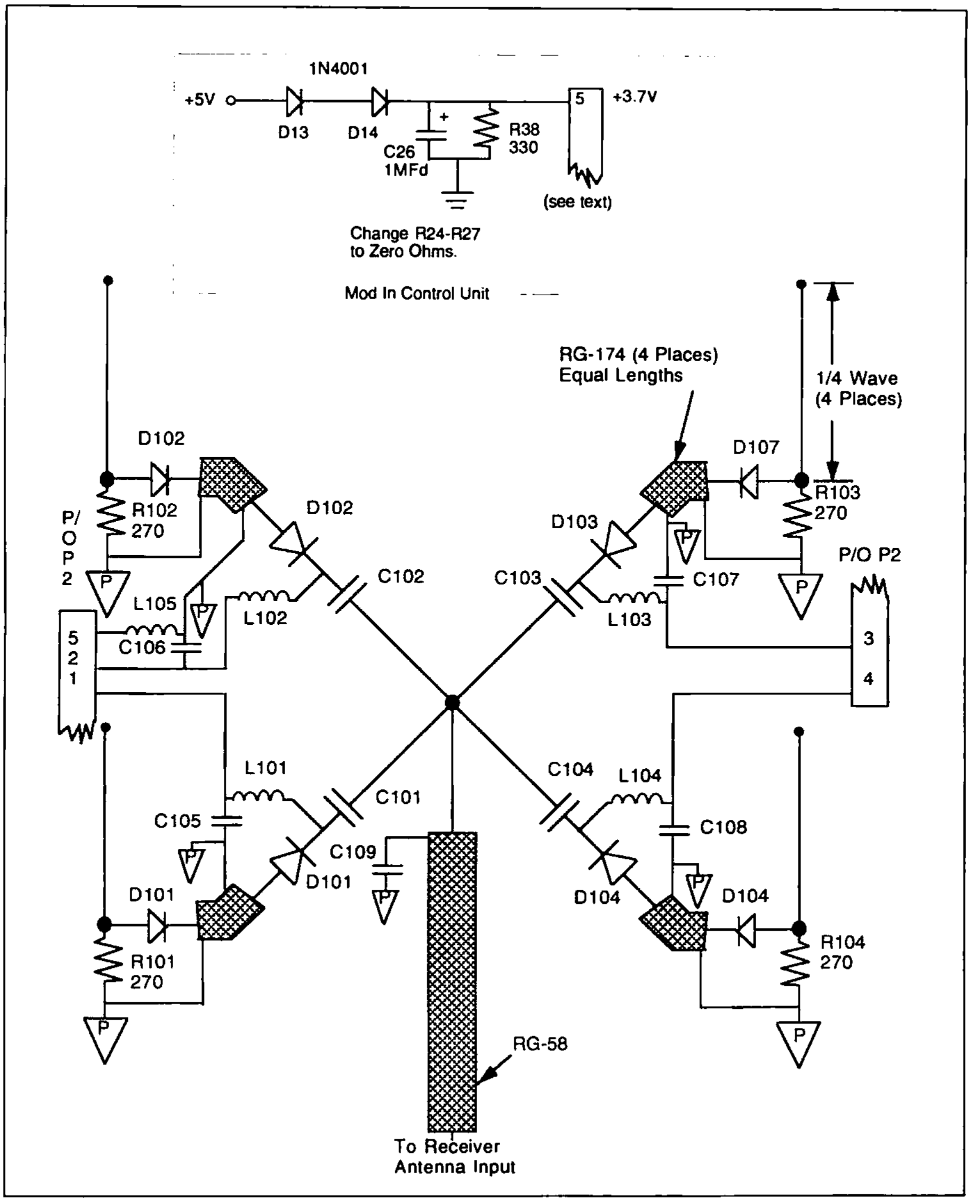


Figure 3. Schematic diagram of the new wideband switcher for the Roanoke Doppler. The P-in-a-triangle symbol denotes a connection to the ground plane sheet. Components values are for an array centered on 2 meters. All capacitors except C26 are 680 picofarads. See text for data on D101-D108 and L101-L105.

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119.

Converting the TV Tuner, Part 2

This month I will cover the frequency stability application or synthesizer control circuit for the CATV tuner, as discussed last month. The main reason to include a synthesizer for frequency control is to remove a wobble in the local oscillator. When the mode of operation is ATV and the bandwidth is 6 MHz wide, stability is not a major concern. However, it is a nice addition, allowing us to only use a TV tuned to a particular channel to receive a known frequency. It eliminates a hassle: frequency uncertainty.

Another use of the CATV tuner would be in a spectrum analyzer application requiring the addition of a sweep/ramp board circuit. Usable frequency coverage with this basic tuner would be 50 MHz to just over 400 MHz with the stock CATV tuner. I will leave this project up to you for now as I have enough irons in the fire at this point. Maybe one of our readers will want to put a circuit together. I would be glad to include any information on this application when it becomes available. Back to the synthesizer.

After sitting down and starting to develop the circuit for a synthesizer control, I abandoned the attempt. The solution hit like a brick—I had developed this circuit many years ago and it is just as applicable today as it was then. The circuit used a Motorola MC-145106 PLL chip and it controlled a similar VCO in the 500-1000 MHz range. Well, I looked that project up in my file and all the work was done, even the script. However, it's not all rosy as it is in a CPM computer format that doesn't permit ASCII transfer, so I still have to rewrite the description. Well, let's hope it gets better the next time around.

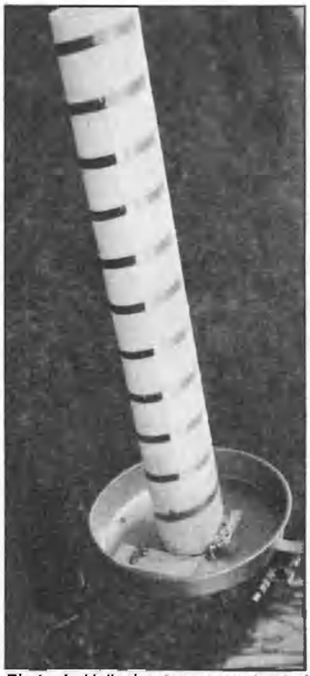


Photo A. Helical antenna constructed for this test. Note pie tin used for helical antenna reflector element.

The synthesizer circuitry is not complex as it only requires four transistors and an 8 MHz crystal for time-base reference. Frequency selection is made by an 8-pin mini DIP switch to programming diodes attached directly to the Motorola MC-145106 synthesizer chip. (For one-frequency control, wire the specific lines to VCC and omit the switch and diodes.) Two transistors are used in a lock/unlock LED indicator circuit, giving you visual "lock" indication. The other two transistors elevate the control voltage from the synthesizer chip to the +20 volt level needed for the VCO "VT" control voltage in unmodified tuner modules. The Motorola chip is not capable of working at a voltage of 19 volts or so, making the transistor interface necessary with higher control voltages. A modification to this scheme is to use a lower control voltage and eliminate the interface transistors from the circuit. I have marked this interface decision point on Figure 1 by an asterisk, "*." Pin 7 by itself will provide control voltages from DC to about 5 volts. The interface will provide from DC to about 20 volts.

The synthesizer diagram provided here is for use with a divide-by ratio of 256, sampling the VCO. Other ratio dividers (128, 64, etc.) are also usable. By making use of different reference division ratios and time-base selections a whole field of options are available. I selected an 8 MHz crystal and divided by 256 to demonstrate the synthesizer functions. A multitude of clock frequencies are possible, it's just that with an 8 MHz crystal the synthesizer will step in 2 MHz steps over its lock-in range.

Programming pins on the Motorola synthesizer chip count backwards, with pin 17 having the least BCD value and pin 9 having the most BCD value (the BCD value for pin 9 is 512; pin 17's is 2). The minimum increment this scheme can be set to is every even MHz; an odd frequency, such as 603, is not possible.

In this scheme I used an 8 MHz crystal for the reference. The BCD value to be programmed into the synthesizer chip is the operating frequency. So, if we desire the LO to operate on 902 MHz, the BCD value should be "902." Consult Table 1 for the pin vs. BCD value of the Motorola MC-145106 synthesizer chip. (Art K6UQH's synthesizer control uses a crystal at 10.47 MHz, allowing lock of a 1067 MHz frequency for the TV normal channel selector control to be used to select stations on 1200 MHz ATV. Check the data sheet on the PLL chip for other frequency schemes).

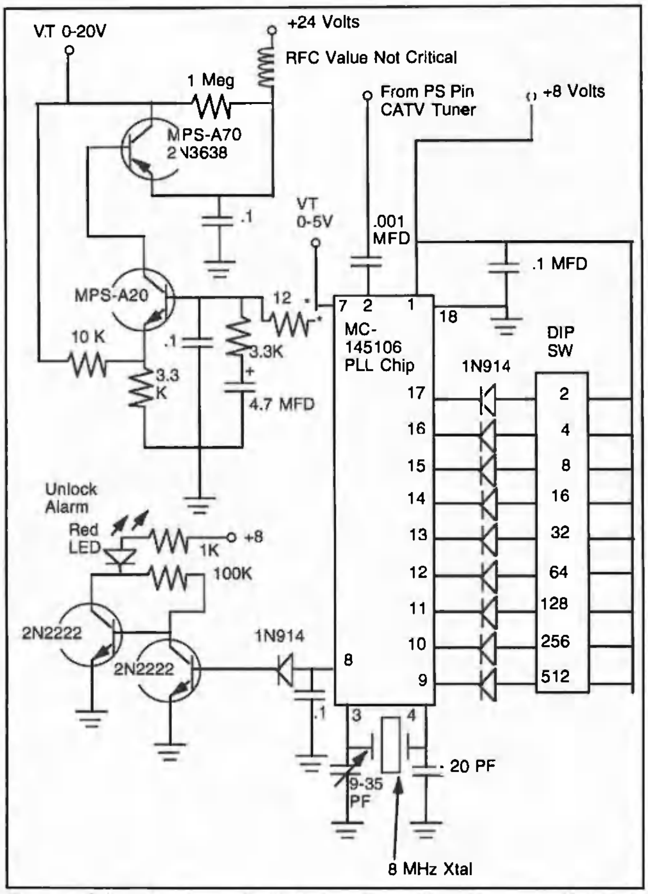


Figure 1. Schematic diagram for Motorola MC-145106 synthesizer control. Refer to the text for an explanation of the "" on pin 7.*

Interconnections between the synthesizer chip and the CATV tuner are minimal. The "PS" line, or pre-scaler output, should be made with a short length of coaxial cable such as RG-174, a mini-diameter cable, and wired directly to the Motorola VCO frequency input. Circuit losses at this point will cause the upper frequency operation to suffer. Use a good ground between the CATV tuner and the synthesizer in addition to the coax ground. Make all RF connections as short as possible by mounting the PLL as close to the PS line as possible.

The frequency-select BCD switch

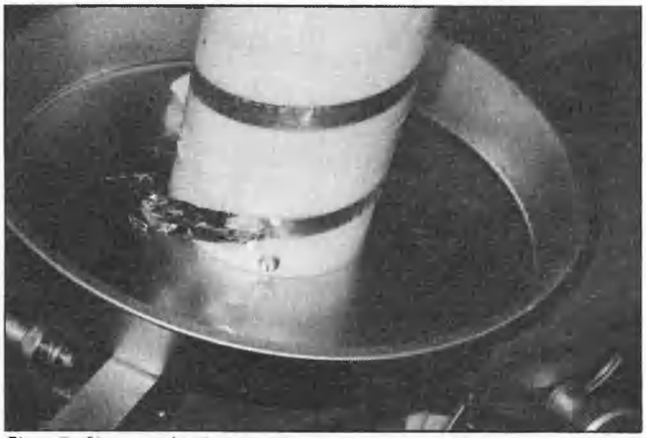


Photo B. Close-up of helical antenna matching section. Use length of copper to adjust match, by varying capacitance to ground (pie tin). Section of copper foil soldered near coax connector and on helical line.

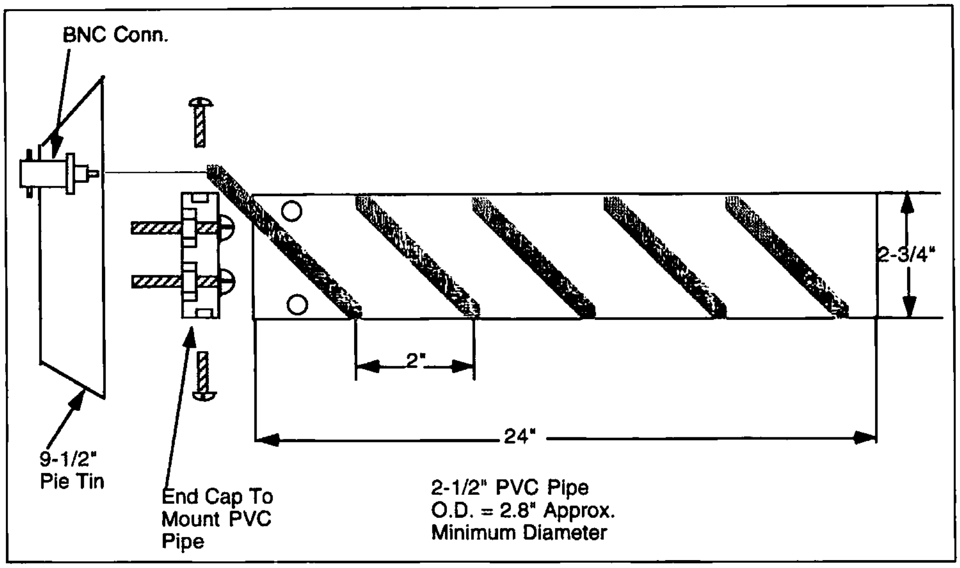


Figure 2. Construction details for the helical antenna for 1240 MHz. Wind a helix right-hand spiral spaced 2" between turns. Use copper foil tape 3/8" wide. Mark off 2" lines to aid in positioning tape on the PVC pipe.

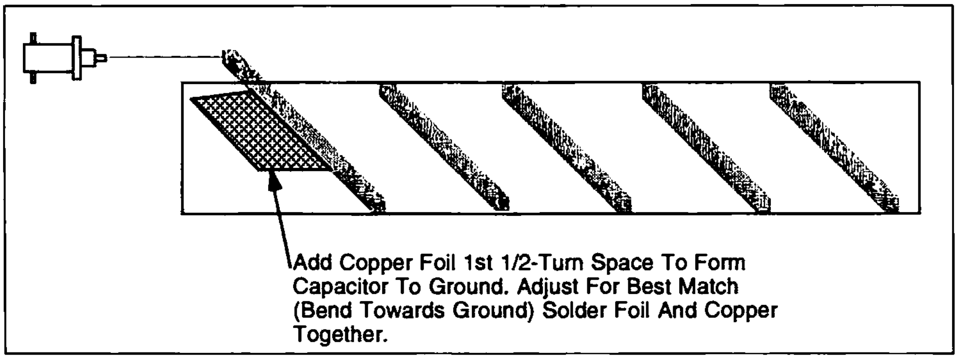


Figure 3. Matching capacitor and coax connection section for the helical antenna (matches 140-ohm helix to approximately 50 ohms for coax feed).

can be any type of switch; I used a small rocker "option type" switch for circuit demonstration. You might want to keep it in the circuit, especially if you want to set the VCO to other frequencies. It's only a matter of frequency agility and your call. In his converter, Art K6UQH hard-wired the VCO synthesizer pins to set 1067 MHz programming. In his setup he switched repeater frequencies with the IF system, his TV receiver. By moving the TV channel selector he could cover 1240 to about 1276 MHz by going from TV channel 7 to 13. That equals going from 174 MHz (Ch. 7) to 210 MHz (Ch. 13) in the IF system receiver.

I think that most folks will follow the basic approach and provide a converter that is controlled from +12 volt operation, and use a calibrated pot to set frequency, making the simple version the one of choice. In this application, if frequency drifts somewhat you can just go to a different TV channel or reset the "VT" tune line voltage. If good regulation and filtering is used, this drift should be minimum for TV applications to allow a tune pot to be locked at one setting for good results. In any case, Figure 1 shows the schematic for the synthesizer if you care to follow this method of frequency control.

Another use for CATV tuners is to make spectrum analyzers out of these units. Coverage would be from 50 to just over 400 MHz and the units could be used as is. For this application you would have to construct a sweeping voltage ramp generator. This sweep generator would control the external horizontal input of a standard o-scope and also drive the "VT" line for frequency sweep. Both the o-scope and "VT" sweeps would be in concert with each other to allow display of the resulting output. The IF output would have to be amplified and logarithmically detected before applying the IF signal to the vertical amplifier of the same o-scope. If I have time I will put something together but for now I'll leave this application up to you.

The 1200 MHz Antenna

An antenna for this frequency band can take several forms, and it can be purchased or home-constructed. The *ARRL Handbook* has shown several designs that can be reproduced, such as the loop yagi. For quite sophisticated antennas a large dish with a coffee-can feed could be used for the 1200 MHz band. If you want to purchase an antenna or parts I suggest you check out Down East Microwave, RR 1, Box 2310, Troy, ME 04987-9721; (207) 948-3741. Bill W3HQT has a variety of antennas and other material for the VHF-to-microwave bands.

If you want to build one on a limited budget and still obtain one that performs with minimal test equipment I suggest you construct a spiral helix. A spiral helix is a short length of wavelength-diameter spiral (coil) that is fed with coax on one end and open on the other. Think of this antenna as a child's "slinky" extended in an open-air coil-like fashion. (A slinky just happens to be about the right diameter to provide gain at this frequency; copper or similar material is better). The beauty is that the helical or coil does not have to be very long as compared to a yagi or similar antenna.

A helix about two feet in length has about 12 dB gain and a beamwidth of about 34 degrees. Adding another two feet in length only increases the gain a dB or so, but decreases the beam width not quite by half. This one fact makes short helixes a simple good-gain wide-frequency antenna to construct. If you want to build up gain in the helix, combine two of them to increase basic gain by about 3 dB.

One problem with the helix is that its feed impedance (one helix) is in the order of 125 to 140 ohms. Feeding two antennas of similar 2' lengths with a split half-wave phasing line will reduce the junction feed impedance to about 60 to 70 ohms. This makes a better match to the coax feedline. Other methods can be used, such as building out the capacitance to ground with copper tabs at the coax connector, will transform/adjust the match from the helix's 140-ohm feed impedance to the 50-ohm range. With a helix transformed to 50 ohms, a simple coax connection is all that is necessary for use.

An advantage of the spiral helix is that its construction is very forgiving in terms of assembly methods or errors in construction. Helical antennas exhibit very wide frequency coverage with good results. I connected the 30 dB preamp (Qualcomm) directly to the helix antenna and noticed the frequency spectrum in the 800 to 1000 MHz range come alive with activity. By rotation of the helix on stations in that frequency range I was able to observe about 12 dB gain when the helix was pointed in the direction of the transmitter. These tests were made inside my garage with the helix about three feet oft the deck. As time permits I plan to mount a 1200 to 1300 MHz filter on the antenna before the preamplifier to minimize the effects from cellular and 900 MHz transmitters which are quite prevalent here in San Diego.

Helical Antenna Construction

A helix reflector is constructed using a sheet of copper PC board material or sheet brass (the brass is most expensive) cut two to three wavelengths square. This is the reflector element of the antenna and serves for the back-mounting of circuitry and support for the helix. I used a metal baking pan 9-1/2" round for the back reflector of my helix and it works well and only cost 99 cents. The actual helix coil is wound on a plastic 3" o.d. PVC pipe. The antenna that Kerry N6IZW and I made used the 3" plastic drain pipe 2' long. Standard 2-1/2" PVC pipe has an o.d. of about 2.8" and is very acceptable. The bottom end of the PVC pipe is firmly attached to the center of our reflector/baking pan.

A plastic or varnished wood plug can be fastened to the inside of the PVC pipe and used to secure the assembly to the inside of the reflector. Mount the bolts to secure the end cap to the reflector before securing to the PVC pipe or else you will have to obtain a 2-1/2'-long screwdriver to do the job. The helix is wrapped with copper tape spaced 2" inches apart radially

up the tube. The bottom end is connected to a coaxial connector at the base end of the helix about 1/2" from the bottom of the coil. I tried several matching schemes, including one using a 1/4-wavelength section of copper foil to attach to the coaxial connector and the bottom of the helix. It used a Teflon strip (shown white in Photo A) with a thickness of 0.010" to insulate the capacitance 1/4-wavelength strip from ground. I tried that method but dropped it in favor of the simple connector and foil gimmick capacitor shown in the photos. The simpler strip worked well and is easier to reproduce.

The transmission line spaced on the 0.010" Teflon was dropped as a method to adjust the helix as others trying to duplicate the antenna would have a hard time trying to locate 0.010" Teflon. Besides, the simple copper tabs don't look as nice but work just as well.

Another method is to ground the helical coil and feed a 50-ohm coaxial connection as a tapped turn on the helix. I haven't tried this method. In any case, there are several methods to try to obtain the best system you can construct. The choice depends on your construction methods and the materials on hand. I constructed several antennas for test purposes and settled on the simple connector and copper gimmick capacitance tabs that I previously described as the easiest to duplicate and construct. This antenna is very forgiving in its measurements and construction techniques. I haven't tried it for transmitting as of yet but for receiving it works quite well in the tests I have performed.

Outside tests here in California should have been quite easy, with the exception of during the rainy season that is dumping on us with little letup in sight. My tests will have to be limited to garage tests and signal reception from this limited location for the time being. Check Figures 2 and 3 for the actual dimensions for the helix antenna construction. Some variation in dimension accuracy is OK; I used the fudge factor of 10% as being acceptable. You do not have to have a micrometer to lay out the construction. Use a PVC or similar plastic pipe—*that's white PVC, not black.* I suspect that black might be OK, but it might have an effect on RF. Diameters for 1240 MHz are of from 2.75" to 3". (The o.d. of 2.5" PVC pipe is just about 2.8". Spacing between turns is 2"-2.1". I wanted a short low-wind resistance helix and I selected a length of 2' long. That gave me 11 turns on the helical coil.

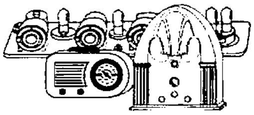
A simple approximation of beamwidth can be obtained by dividing the number of helix turns into 385. In this case, 11 turns equals 34 degrees of beamwidth. I estimated gain to be in the 10 to 12 dB range. Mounting arrangements were made by attaching a 12" section of aluminum angle bracket to the back of the pie tin. This stiffened up the tin reflector and made a mount to attach to a mast or other tower mount. I located the filter and preamplifier up at the antenna on the angle bracket. A secondary preamplifier will be used in the shack when I get time to mount the antenna. The copper tape (3/8" wide) was secured to the plastic pipe with one length of double-sided tape to hold the individual turns during winding. After the turns were properly on the pipe I covered the entire assembly with 2"-wide thick packing (Scotch-type) clear tape. This will weatherproof and hold the copper tape on the PVC pipe for quite some time.

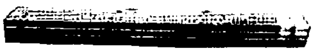
MC-145106 pin numbers:		
17	16	15
14	13	12
11	10	9
BCD value:		
512	256	128
64	32	16

Table 1. BCD value vs. pin numbers. Pull pin high to VCC to enable proper BCD value count.

Well, that's it for this month. I hope you have enjoyed the 1240 MHz ATV and other aspects of this project. Next month I plan to cover SWR as it applies to both VHF and microwave. If there is space I'll add some easy-to-assemble filters for 1 to 5 GHz.

Parts availability is still good and I will make the RF tuner with a Qualcomm preamp available for $25 postpaid; additional tuners or preamps add $10 each. (California destinations add state tax). As always, I will be glad to answer questions on this and other related subjects. Please send an SASE for prompt reply. 73 Chuck WB6IGP.





ASK KABOOM

Number 17 on your Feedback card

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

A Cure!

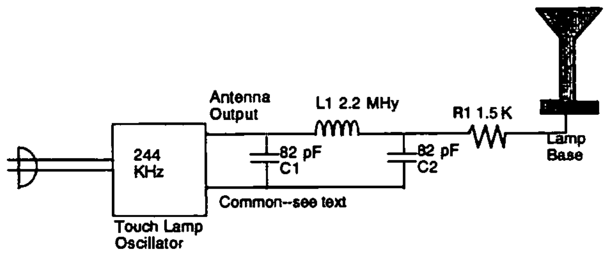
In a recent column, I printed a letter from a ham who was having trouble with touch lamps. Now, we all know how annoying those things can be, with their harmonics all over the radio spectrum. This unfortunate soul, however, was having the reverse problem: His transmitter was turning lamps on and off all over his apartment building! I promised I'd print a cure if any reader had one.

Good ol' ham ingenuity came to the rescue! Leo AC4DA has grappled with the touch lamp monster and won. He was kind enough to give me permission to print his fix, so here it is. I have no opportunity to test it, but it makes a lot of sense, and Leo clearly knows his stuff, so I'd be awfully surprised if it didn't work. Here's an excerpt, with some paraphrasing, from Leo's letter:

A touch lamp consists of an oscillator with the output attached to the lamp base and shade frame, a circuit that detects a shift in oscillator frequency when the lamp shade antenna is touched, and a switch circuit to turn the bulb on and off.

I checked a lamp and found the oscillator frequency to be 244 kHz, with many strong harmonics. My corrective method is to tune the oscillator output to the lamp shade antenna with a PI network. This peaks the fundamental and sharply reduces harmonics, which greatly reduces interference from the lamp to TVs and radios. It also sharply reduces incoming signals *to* the lamp, which is the goal here. The lamp circuit is decoupled even more from incoming signals by the addition of an attenuator resistor in series with the antenna lead. (Also, considering the unpredictable impedance of the "antenna," the resistor probably helps keep the antenna reactance from disturbing the filter's action—KB1UM.)

To find the lamp's oscillator frequency, connect a clip lead between the lamp shade and the antenna input of a receiver which can cover such low frequencies. Then, tune around until you find the signal; it won't be hard. (To be on the safe side, I'd try loose coupling with some wire near the receiver's antenna. If direct coupling turns out to be necessary, at least use a small-value capacitor, perhaps a couple of hundred pF, in series, to avoid any AC line currents which might blow your rig's front end out the window—KB1UM.)



L1 2200 MHy J.W. Miller 9250-225
Allied Cat. No. 871-3270 $3.36

R1 1.5K 1/4 W--see tex $0.03

C1,C2 82 pF 1000V Disc Ceramic
Alectron SE-1026
Allied Cat. No. 285-1026 $0.05

Figure 1. A solution for a 244 kHz touch lamp (see text).

Once you know the frequency, you're ready to make your filter. To install it, you must locate the lamp's oscillator output lead; it's the one that attaches directly to the inside bottom of the metal base. The Pi network shown in Figure 1 was designed for my 244 kHz lamp, but it can work with other frequencies if you use variable components. Simply tune both caps and the coil for maximum signal on the receiver's S-meter. Naturally, if you have a scope, that makes things even easier. (If you don't have a variable coil, you still can probably get plenty of frequency range with the two variable caps—KB1UM.) If the signal overwhelms your receiver, either switch in its attenuator or move the lamp's output farther from the radio's antenna input.

A different L-to-C ratio could be used; I used what I had available. C1 and C2 are rated for 1,000 volts DC because the lamp circuit's common "ground" to which they are connected

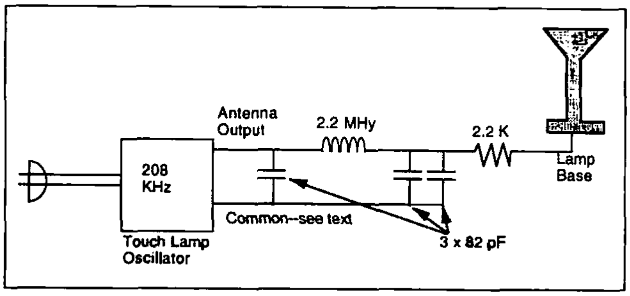


Figure 2. A solution for a 208 kHz touch lamp (see text).

may in fact be one side of the AC line! Don't skimp with lower-rated caps or you could create a serious shock hazard.

Start with 5k ohms for the attenuator resistor R1 and see if the lamp still turns on and off when you touch it. If not, reduce the resistance value until it switches consistently. If your lamp is at another frequency, some experimentation may be in order. When I modified another lamp, which was at 208 kHz, I had to add another 82 pF cap across C2 and change the attenuator resistor to 2.2k ohms, as shown in Figure 2.

This was a simple but satisfying project. The best part? My wife is pleased with it!

Thank you, Leo, for a well-thought-out solution to a vexing problem. I've been hearing about these darned touch lamps for years, and yours is the first reasonable cure I've run across. Good job!

Other Kinds of Interference

This discussion of touch lamps makes me think about other kinds of interference. One problem I've run into many times is harmonic output from switching power supplies. The ones in desktop computers are usually completely encased in metal, so they don't make much, if any, noise. And, their output leads are confined within the computer's metal case, so no RF gets out that way either. The only exposed item is the AC line cord, which seems well enough filtered that it's pretty quiet. Other kinds of switching supplies, though, often have little or no shielding, and they can make quite an RF racket. The little one on my fax machine is a doozy, and my camcorder's charger/adapter is even worse. Both of these supplies are in plastic cases, with only a small internal shield.

Is there a fix? Unlike with the touch lamps, the output of a switching supply cannot be interrupted with a PI network filter. At least, not as far as I know. You'd need a very low-resistance, high-current inductor which could handle lots of current. And, many switches malfunction if there's a lot of inductance on the output line. So, electrically, you're in a bind. The only cure of which I am aware is mechanical shielding. A good metal box and perhaps a toroid around the output lines can help. Frankly, I haven't been very successful at quieting these things down.

And what about microprocessors? Everything from my fax to my VCR radiates some amount of wideband noise, thanks to the digital goodies inside. By their very nature, digital signals are rapidly rising and falling pulses, which means lots of RF hash all over the spectrum. It's not real strong, but it can be strong enough to get into a ham receiver, a TV or a shortwave, especially with an indoor antenna. Electrical filtering within the offending box is pretty much out; you can't stop the pulses or you stop the digital device's operation. You can, of course, shield the device in metal. Also, lines coming in and out can be filtered with toroids. Much digital noise is pretty high in frequency, so those toroids can really make a difference. In fact, they're one of the few fixes I've ever actually seen work.

Hello? Hello?

Telephone circuits can be very susceptible to RF fields. The phone company does sell filters which can help quite a bit. But, with today's all-electronic phones, QRM to telephones has gone up, thanks to all those nice, rectifying diode and transistor junctions in there. With the old phones, the only active circuitry was in the touch pad; the voice circuits had nary a single transistor, so it was pretty hard to induce a signal. Ah, the good ol' days!

Cordless phones and baby monitors are another matter. Most operate in the 46/49 MHz band, which is pretty far from our operations, except perhaps for 6 meters. I've never seen one get into ham reception, but I have seen nearby transmitters of various kinds get into the phones. In fact, I saw one case where a mysterious pulsing noise was coming from a baby monitor's receiver. Thanks to my ham training, I recognized the pulses as Morse code! The letters made no sense, though, and I guess I'll never know where it was coming from. But it sure was weird to hear it on a baby monitor at 49 MHz.

Well, that's it for this month. Until next time, happy interference-free communicating and 73 de KB1UM.

Number 18 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors, Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Getting a Taste of Radio

As the delicious aroma of broiled lobster wafted down the hallways of Intermediate School 72 in Staten Island, New York, every child in our school wished that he or she could be in the ham radio program. When the "Eyewitness News" television camera arrived, it looked like a rock concert crowd outside my classroom door. How did this excitement get generated? Through contacts on the radio, of course.

In early fall, Jim Wilmerding N4MDC and I worked out the schedule for what we believed would be some exciting school contacts that term. Little did we know the level of excitement we were igniting. Jim is the Project Director of the Island Institute Schools in Rockland, Maine. A dear friend for many years, Jim and I have always shared the philosophy that using ham radio to stimulate interest in school curricula is almost always a terrific experience for the students. Since the Island Institute offers educational resources for the 14 island schools in this scenic part of Maine, Jim knew that introducing ham radio to the small island schools would be a great educational experience for those students, and for mine as well.

One of the first small fishing islands we spoke to was Frenchboro. This island has a one-room schoolhouse with eight children in grades K-8. Imagine my trying to describe this to my 13 ham radio classes in grades six, seven, and eight. Our total school population is 1,800 plus. When the children first made radio contact they all appreciated the fact that even though both schools were located on islands, Staten Island was very different from Frenchboro Island. The differences and similarities became the focus of most of our contacts during the next few months.

Filling in the Picture

My students came up with the idea of sending souvenirs, videotapes of our school, scrapbooks, and reports about Staten Island and New York City to their counterparts in Maine. I chose a team of students to take video footage of our physical education classes in the gym, our assembly programs, our shop classes, the school cafeteria, and various classrooms. The favorite footage of the children at Jim's end seemed to be our kids speaking with them on the radio. They also got quite a dose of "culture shock" when they saw footage of 563 sixth-graders all having lunch together. Many "oohs" and "ahhs" were reported from both ends as a wonderful letter exchange began between the two groups.

We have also made contact with four other island schools in the system. My students have had the fun of speaking with children at the Longfellow School on Great Cranberry Island, the Islesford School on Little Cranberry Island, the Swan's Island School, and Chebeague Island School. All my students got so caught up with the excitement of the contacts each week that a spontaneous outpouring of the most wonderful scrapbooks began to arrive in my room. Students put together scrapbooks showing all the fast-food restaurants, supermarkets and movie complexes on Staten Island. Several youngsters did a project showing the various stores and attractions at the Staten Island Mall. We collected maps, brochures, travel folders and family photos all depicting a young child's life on our island in New York.

Photo A. The children were excited when the lobsters arrived from Maine.

One of the best projects was that of two students who videotaped a trip into Manhattan as seen from the Staten Island Ferry. Jim's kids were so amazed to see that the largest ferry, the *Samuel Newhouse*, carries up to 6,000 passengers. The smaller ferries carry up to 1,280 passengers and 40 vehicles. The five-mile ride past the Statue of Liberty, Ellis Island, the Verrazano Bridge, and other famous landmarks was recorded on tape by my students.

All the children's projects were shipped out in large cartons to Jim for distribution amongst the island schools. According to Jim and to the island teachers I spoke with, they were simply overwhelmed at the wealth of information collected by my students and forwarded to them.

Next began the wonderful reciprocal exchange between the schools. Jim sent us photos of the various island schools, along with a videotape showing the island children on board their fathers' fishing boats. My classes sat mesmorized as they watched kindergarten and first- and second-grade youngsters handling lobsters and crabs as they explained how the traps were constructed and used. All the geography and social studies books about Maine could not have had the educational impact on my students that the letters, books, tapes, and radio contacts did. They were talking about things they learned to their other classes. Other teachers reported back to me how excited the children in the ham radio program were about what they were doing and learning with the kids in Maine.

Lobster for Lunch

Unbelievable school-wide interest and excitement broke out when Jim announced on the air one day that he would be sending us six live Maine lobsters. I enlisted the help of Ms. Sheilah Sukhedeo, our home and career skills teacher, to do a team teaching (and eating) lesson with me. I chose one student from each of my 13 classes to participate in the "Lobster Fest." One of my seventh graders, Billy Daddio, volunteered his father, who is a chef, to help us out. We also invited several parents from our supportive PTA to join us at the table.

The Maine Lobster Promotion Council sent us a carton of goodies that really added to the festivities that day. They sent lobster pins, caps, posters, nutritional guides, and recipe books for the children. They even included lobster crackers and an apron for the chef. Ms. Sukhedeo and Mr. Daddio did an incredible job showing the children how to prepare the lobsters and then how to cook them. They were both so knowledgable that it became one more incredible learning experience for my students. Three children had never seen or eaten lobster before.

A local restaurant, Real Madrid, donated colorful lobster bibs for everyone. Parents provided side dishes to have with the lobster, and a fabulous table was set. Even the photographer and reporter from our local newspaper joined us for lunch. Parents, our principal Ms. Barbara Glassman, other administrators, teachers, and children; all breaking bread together as the culminating activity of a ham radio experience provided quite a picture.

After a delicious lunch prepared by the students, we went back to my room in time for the TV cameras to capture my children and the principal getting on the radio to thank Jim and Ron Cote, the principal of the Chebeague Island School, for sending us the lobsters. We even had a chance to thank Mr. Thomas, who packed and shipped the lobsters for us, on a later radio contact.

I do not know how this radio experience could have been any better from an educational and cultural point of view. I received "thank you" notes from some of the parents, who assured me that their children would always remember the Lobster-Radio Day and all the things they learned. Is there anybody out there who still doesn't see the value of ham radio in a classroom?

Photo B. After lobster lunch we went back to the ham shack to thank Jim and his students. (Billy Daddio at left.)

NEVER SAY DIE

Continued from page 4

into. Health, education, crime, entertainment, the arts, and so on. Please note that I have not even hinted at your going into business making a ham product. I can't think of anyone who's gotten rich selling a ham product. We hams are famous for being frugal. A few hams have started out in the ham business and then gone on to make more commercial products with success. Tough way to start.

Read magazines and books. Look for new ideas which can be commercialized. When I was working as an engineer for Airborne Instrument Laboratories I ran across a chap who'd invented a great new microwave antenna. I pointed out that microwaves and audio had the same wavelengths, so he'd inadvertently invented a new kind of loudspeaker. We spent a summer developing a prototype, and then I set up a company and started making 'em. He stayed with AIL.

These days I see opportunities for new products and services at every turn. My problem has been finding the people I can depend on to follow through. There's just so much I can do by myself, and then I have to depend on others. That's been a major problem for me, so I do what I enjoy . . . starting new businesses, getting them going, and then I tend to sell them off to get out from under the need to keep managing them, which prevents me from being able to start new businesses. I really hate having to work with the financial reports, which becomes a full-time responsibility by the time you have a half dozen businesses.

Since I can't do it all, it's up to you to get off your . . . er . . . couch, put down the TV remote, and get busy starting new businesses. How many magazines are you reading a month? Well, I'm probably reading and checking through several times as many. How many books a month?

Auto-Ident

If you've been making any effort to learn about digital communications, you have a license to develop the new products we'll be seeing. I've discussed some of these in my past editorials, which you've let go into one eyeball and out the other. The time is not far off when we'll be building into our rigs an already available inexpensive chip which will identify our transmitters for us automatically. The next and obvious step is to design (and sell) a decoding unit for receivers which will completely change amateur radio. This will be an even bigger change than came about with repeaters, where we standardized channels and made it possible to make contacts with friends just by listening on one frequency.

With a receiver which can be programmed to alert us when someone is calling us, we're going to move into a new era. On the high frequencies we will be able to have our receivers tune the bands for desired callsign prefixes, or for the callsigns of friends. We probably should establish a few calling channels to be used for initiating contacts. When a contact is made the operators would then move to an unused frequency to carry on, freeing up the calling channel.

Now, you can wait for all this to happen, or you can be one of the entrepreneurs who develops the system and collects royalties on it from the ham gear manufacturers. Or you might, if you have the same defective genetic problem I have, go into business manufacturing the needed accessories.

With that kind of operation made possible we just might be able to attract more hams to our hobby. It'll help make hamming more like using the telephone, but with the advantage of almost unlimited groups getting together to talk.

Another innovation which it is about bloody time we started working on is duplex hamming. Lordy! Here we are in 1995 and we're still making one-way transmissions to each other . . . and over to you. That's stupid. In past editorials I've discussed several ways of solving this, but not one of you has, as far as I know, bothered to do one blessed thing. The telephone company has been able to provide duplex operation, even on overseas calls, for over 50 years, while we hams are just one small step ahead of buzzing each other with spark gaps, using our beloved Continental Code. It isn't Morse Code that we have been using, by the way. Instead of lying there on the couch guzzling beers and smelling the flowers, some of us would do better to sniff some Energine and get a move on.

"Another innovation which it is about bloody time we started working on is duplex hamming."

Where's Fax?

Just because the Japanese engineers who have been designing about 95% of our ham rigs haven't built in a fax jack so we can exchange faxes is no reason for you to sit there scratching your . . . er . . . ear. How about building a fire under your soldering iron and whupping up a circuit we can install in our radios so we can plug a fax machine into our rigs?

Wouldn't you like to be able swap diagrams, magazine articles, and stuff like that? If I see any signs of activity along this line I'll start the ball rolling by announcing that permission is granted to fax any pages from *73* over the air. This should help get around any possible copyright problems which might, but are unlikely to, arise.

I don't know about you, but when I read magazines I tend to tear out the articles I find of special interest. I've got two file drawers full of this stuff, all filed according to subject. I'd like to be able to answer questions I get over the air by not just explaining something, but also by being able to fax an article of two on the subject which the other chap will find interesting. I know that I'd be on the air far more often if we had something like that.

Readers now and then take the trouble to clip articles they think I'd be interested in. I read a lot, but I sure can't read everything, so I really appreciate getting articles on cold fusion, educational advances, health care advances, ham radio, submarines, ragtime, and so on. Until we get fax working with our ham rigs, use Sam's Snail Mail.

Of course, once there's a way to swap clippings, I'll have to index mine and scan them in so I can have my computer send them without me having to find the right file folder and look through for the wanted article. Oh well, I have my books, CDs, and my videotapes pretty well indexed, so what's one more index?

That reminds me. Years and years ago (1930s) one or two of the broadcast stations (WOR was one) were sending newspapers by fax at night, but it never caught on. Now how difficult would it be to FM a broadcast band carrier (phase-shift) enough to run a fax machine? Radio stations could offer this as an additional service, right along with their normal broadcasting. One of the things I've been hoping to find time to do is try out a talk-show format for radio where I would discuss new music releases I think people would like, books, poems, and discuss solutions to our major social and political problems. With a fax system also available I could have the listeners get faxes of background material on the things I'm discussing. There's an awful lot of good stuff on the radio that is heard once and lost.

It wouldn't be long before we had fax tuners which would check all the local radio stations for faxes on material we program it to pick up for us. Our computers would save it for us to check. We could then print it out or just erase it.

Someone will probably develop such a system and make millions on the royalties. Put me down for 10% for the idea, okay? I described the first laptop computer to a Japanese friend of mine. He went to Kyocera in Japan and convinced them to make it just as I had described it to him. He then got Microsoft to do the software I'd suggested, and it's been the most successful laptop computer in history. No, I didn't get any money or even credit, and my friend stopped talking to me and is now a multi-millionaire. When I see whole magazines devoted to laptop computers, I enjoy knowing I had a part in their development. Oh, I know laptops would have come along anyway, so I just played a small part. But I get satisfaction out of knowing that I've helped a little to move the world along with cellular telephones, computers, music, and so on. How about you, what have you done so far? Do I have to come up with the ideas for you and then push and push to get you off dead center?

Here's Another Idea!

How about inventing a simple pair of roller skates that can be quickly stepped into . . . something like putting on skis these days? Make 'em light. The idea is to make it easy for people to put on the skates to get around town fast, and then take them off when they pop into a store, on a bus, or the subway. People need something like this to get around our cities quickly. It would beat the heck out of walking.

Not everyone knows how to skate now, but if a product like this were available, we'd have octogenarians skating. The next thing you know we'd see more streets closed off from vehicles and lanes for skating. I suppose we'd want both in-line and the old four-wheelers. I know I'd be right up front in line to buy a pair, and the shoes needed to mate with them.

I remember seeing a TV segment on the chap who invented the in-line skates. He got shafted by the manufacturer, so he's trying to invent another new product and maybe be a little smarter on the business end next time. If you know where I can get in touch with this chap, I have the idea he needs to make zillions. You could too, but I can't get you away from watching ball games on TV and wasting what's left of your life rag-chewing on 75m or the local repeater.

Your Other Legacy

Your wife is probably used to being a "radio widow," mostly getting to see the back of your head at the operating table. But are your kids radio orphans? Is your family really a one-parent family? A recent study showed that the average American father spends five minutes a day with his kid. Five lousy minutes? And then he grumbles about family values not being taught, and wonders later why his kid has "gone bad." OM, your kids are the most important legacy you're going to leave when you get your treasured Silent Key award from the ARRL. You better figure out some way to spend more time with 'em.

Read to 'em. Tell them stories. Find out what problems they're having in school, or even with you. Be a dad, not just that guy sitting there at the rig every night telling them to keep the hell quiet. The average kid spends three hours a day in front of the television. That's a terrible habit to give them for life. Start early and make TV a privilege, not a right. You might insist that they only watch videotapes. In that way you can guide their viewing

and not let them get hooked on stupid sitcoms and trash TV like Oprah or Geraldo interviewing 400-pound black lesbian mothers.

Get them interested in reading, in poetry, in classical music. Help them learn skills such as skating, ice skating, skiing, swimming, juggling, bicycle riding, some magic tricks, building electronic kits, using tools, repairing things. Do your children have their own desks and quiet place to study? Do they have a workbench, tools, and some test equipment? How about their own computers? And not for games. How about a chemistry set? How about painting? What musical instrument are you encouraging them to learn?

I've seen Novices of four, and an Extra Class girl of nine. Get your kids going and they'll be showing you how to handle packet traffic and make satellite contacts.

Yes, I know it's difficult to break your own habit patterns, so why not try to spend 10 minutes a day with your kid instead of five. It'll be a start. My father didn't spend five minutes a month with me, and I've never forgiven him.

Well, that's enough lecturing. Now stop screwing up. Start reading some of the books I've been recommending. Did you get *Kinship With All Life* yet? If your kids are young, start reading the Oz books to them. I've been wanting to put these all on tape for kids for a couple of years now, but there never seems to be time. I've got every one of L. Frank Baum's Oz books. Did you see that wonderful TV movie they did of him a few years or so ago? I've got it on tape so I can see it again now and then.

I also want to tape all of Ernest Thompson Seton's animal stories. They're fabulous and I've got most of his books. For adults I want to do tapes of the Kai Lung stories by Ernest Bramah. His books are terrific. Sigh.

But then, as I walk through my library I see book after book that I know you would enjoy. Benchley, Stephen Potter, H. Allen Smith, Parkinson. It's even worse when I start going through my CD collection. You ought to hear this . . . and so on.

Raising the best possible kids you can is not intuitive. You not only have to overcome your own crummy training by your parents and the great American school system (which is a disaster of major proportions), you also have to fight against the currently entrenched systems for dealing with children. And then there's the peer-pressure monster.

I've covered much of this in my book *Declare War* and the updates, which I'll eventually put together as a second book. I should do a book just on how to raise the best children you can.

Children, like dogs, are programmed to please (called instinct), but unless you take the time to give them the training they need and want, they'll cause you and themselves trouble.

Now, how come your nine-year-old children or grandchildren aren't Extra Class hams? Why are they dressing in peer-induced clothes? Why are they listening to rap and punk rock instead of classical music? Hey, they're what you've made them. Or neglected to make them. Five minutes a day, eh?

No More Novices?

What do we really need the Novice Class license for now? Now that we have the no-code Tech Class license, the only major difference between that and the Novice Class exam is that the technical questions are a little harder.

Old-timers who predate the Novice license may remember that the whole purpose of the license was to give newcomers an easier way to learn the code. The idea was to start them slow at 5 wpm and let them build up their speed by getting on the air in the Novice CW bands and build up to 13 per.

Two things have changed since then. Two important things. Important enough to get the FCC to reconsider the value of the Novice license. First, with the value of the code approaching zero as far as providing trained operators for the military in time of war, which was one of the original reasons for maintaining the code requirement, there is no valid reason for continuing to demand that all newcomers develop code skills. Yes, until the ITU removes the requirement for "a knowledge of the code" we'll have to make sure that licensees have that. But this is fulfilled by a 5 wpm test, and I now have a booklet out which explains how anyone can pass the 5 wpm test with less than one hour of training. Most people can do it in 20 minutes. (See the ad on page 67.)

The Continental Code (we don't use Morse) is as passé today as spark transmitters. Oh, I'm not putting CW down as a fun mode. I'm just pointing out that it has no practical use in the world of 1995 other than as a fun reminder of the long past which lives on in amateur radio and Newington.

Note that I am not going to say one single word about the effects of keying a powerful transmitter on and off near the human body may have on the operation of that body. Nor am I going to upset Extra Class hams by pointing out that although virtually all hams are crazy, by far the worst offenders are Extras. I would never say that, since some of my worst enemies are Extras.

Oh yes, the second basic reason why the 5 wpm Novice code speed is stupid. One of the reasons millions of potential hams have been kept out of the hobby has been the code skill requirement. This began to break down when the Novice license was initiated.

Before that we all had to start out at 13 wpm. One thing we didn't know then was how the mind leams to copy the code. The system, from the beginning, was to start people off slow and gradually build up their code speed. This invariably led to the mysterious and infamous 10 wpm "plateau." Scientists didn't find out until fairly recently what was going on. Now we know that the graduated speed method is a major bummer.

As I've explained endlessly (well, it seems to me that it's been endlessly, but every time I bring it up at a hamfest talk it seems to be a news flash to most of the people present), when you start out learning the code the usual system is to leam the characters and then listen for the dits and dahs. Dah-dit-dit. Hmmm. Let's see, oh yes, that's a D. In computer terms you set up a look-up table in what's left of your mind after our school system has gutted most of it, and compare the dahs and dits with this. The problem here is that the table is on one side of the brain and your ears and hands on the other. The brain was probably designed that way to allow us to play the piano and other musical instruments without having to think about every finger movement. And to type.

When the brain reaches its clock speed, which is about 10 wpm, that's all there is folks. Plateau. Now you have to start all over and learn the code as you should have in the first place, letting your fingers write or type the characters when you hear the code patterns. No thinking allowed. Thinking just stops everything, as you've probably noticed when you miss a character. Then you miss a bunch before you get back on automatic.

In view of this understanding of how the brain works, you can see that the Novice 5 wpm test as a way to help newcomers get up to 13 wpm is not just totally unscientific, it's stupid and defeating to the whole purpose of the license class.

So let's do away with it. It's causing newcomers endless misery and is doing the hobby serious harm. When you look at it in this perspective the Novice Class offers zero benefits and is seriously damaging to amateur radio.

Combining the Tech and General Class Licenses

Just as there is no rational reason for the Novice license, there's also no good reason in 1995 for demanding the 13 wpm test for the General Class license. So let's reinstate the same technical exams for Techs and Generals and thus be able to dump the Tech license. About the only use for the code these days, as I mentioned, is as a fun mode for hams. So let's let the hams who want to use CW do it and stop using the code copying skill as a way to keep this an exclusive hobby. What do I have to do, bring a class action lawsuit on behalf of the general public against the FCC and the ARRL to break this link with the distant past?

With us using about 0.13% of our allocated frequencies, and with our virtually unused ham bands the ones which promise the most value for us in the future, we're going to be big losers if we don't get in some youngsters to help populate our empty bands. With the average ham age being in the 50s, you know as well as I do that few of us older hams have the gumption or the time to pioneer new bands and modes.

"So let's let the hams who want to use CW do it and stop using the code copying skill as a way to keep this an exclusive hobby."

The fact is that amateur radio paid back the public for the use of our bands when the average ham age was in the 20s and 30s, and since the League's Incentive Licensing brainstorm 30 years ago, we haven't been worth beans as far as our contributions are concerned. We've almost stopped inventing and pioneering. That takes youngsters.

Why the Extra Class License Today?

20 wpm code? Give me a break! For what? For a few lousy kHz of exclusive CW and phone bands. Big deal, 25 kHz on 75, 40, 20, and 15 meter phone. And ditto for CW on those bands. Let's cut out this elitist baloney. I'd eventually like to see one class of ham license, as I've mentioned before. Plus I'd like to see us experiment with removing mode discrimination on a band and see if it helps or hurts us. In the meanwhile, let's take an intermediate step and combine the Extra and Advanced Class licenses. We can do that by getting rid of the 20 wpm code test and using the current Extra Class technical test. This is supposed to be a technical hobby, right? Well, let's make it that.

We could rename the Novice-Tech-General Class license Class B, or Peon Class, and the Advanced-Extra as Class A, or Elite Class. Just kidding. Sorta. And if there are any militant political correctness jerks out there who object to me using the word peon, go jump in a nearby lake. Or a remote one.

SPECIAL EVENTS

Number 19 on your Feedback card

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by October 31. Provide a clear, concise summary of the essential details about your Special Event.

APR 1

COLUMBUS, IN The Columbus ARC Hamfest will be held at Bartholomew County 4-H Fair Grounds, Family Arts Bldg., State Road 11, 8 AM-2 PM. Set-up Fri., Mar. 31st, 6 PM-10 PM. Talk-in on 146.790/.190. Make reservations through *Marion Winterberg WD9HTN, 11941 W. Sawmill Rd., Columbus IN 47201. Tel. (812) 342-4670.*

LEBANON, PA The Appalachian A.R. Group will host a Hamfest/Computer Show at Lebanon Fairgrounds, starting at 8 AM. VE Exams begin promptly at 9 AM (gather at 8:30 AM); pre-reg. requested. Lateness will result in disqualification. A fee payable to "AARG" will be collected at the Exam. Please bring original and a copy of your current license, and two forms of I.D. Registration deadline is Mar. 1st. Contact *Roger Engle WN3U, 979 Radio Rd., Elizabethtown PA 17022. Tel. (717) 367-2230.* Talk-in on 146.04/.64. Send check for Flea Market reservations to *AARG, 105 Walnut St., Pine Grove PA 17963. Tel. (717) 345-3780;* or *Lanny Hoffman KD3TS, 337 N. 19th St., Lebanon PA 17042. Tel. (717) 274-2148.*

LONGMONT, CO The annual LARCFEST will be sponsored by the Longmont ARC, 8 AM-3 PM, at Boulder County Fairgrounds, Hover and Nelson Rds. VE Exam at 1 PM. Talk-in on 147.27/.87 and 146.52. Contact *Randy Stevens N0NMD, 5280 Cypress Dr., Boulder CO 80303. Tel. (303) 499-1106.*

ROCHESTER, MN The Rochester ARC will sponsor their 18th annual Rochester Area Hamfest/Computer & Electronics Show. VE Exams. Flea Market. Speakers and programs. Contact *Rochester ARC, Attn.: Frank Ingram N0MXN, 1627 5th Ave. SE, Rochester MN 55904. Tel. (507) 288-6569.*

SPOKANE, WA The Eastern Washington SECTION Hamfest and Computer Show will be held at Spokane Interstate Fairgrounds, N. 404 Havana. The Inland Northwest Hamfest Assn. will sponsor this event 9 AM-5 PM. Setup Fri., Mar. 31st, 9 AM-6 PM. VE Exams. Seminars. Contact *Warren Kelsey KJ7BB, S. 1405 Crestline, Spokane WA 99203. Tel. (509) 534-8443.*

APR 8

FERGUS FALLS, MN The Lake Region AC will sponsor their 8th annual ARRL affiliated Hamfest, 8 AM-3 PM, at the Hocky Arena, Otter Tail County Fairgrounds. Set-up Fri., Apr. 7th, at 4 PM. VE Exams, ARRL Forum, MARS, Packet. Talk-in on 146.040/.640. Please contact *Wm. Morgan, Rt. 6 Box 43, Fergus Falls MN 56537.*

GREEN BAY, WI A Ham Radio & Computer Flea Market will be held at Ashwaubenon H.S., 2391 So. Ridge Rd. Sponsors: Ashwaubenon H.S. Tech Club and Brown County ARES. Set-up Apr. 7th, 7 PM-10 PM. VE Exams; register 8 AM-9 AM. Talk-in on 147.075(+). Contact *Chad Stiles N9PAY. 2171 Barberry Ln., Green Bay WI 54304. Tel. (414) 494-2936;* or *Lisa Kolbusz N9VJL, 520A Columbia Ave., Green Bay WI 54303. Tel. (414) 497-1807.*

JOPLIN, MS The Joplin ARC will hold HAMFEST '95 at the John Q. Hammons Trade and Convention Center, 3615 S. Rangeline (adjacent to the Holiday Inn). Time: 8 AM-3 PM. Set-up at 6:30 AM. ARRL Exams at 10:30 AM (pre-reg. not reqired). Bring original current license or CSCE, copies of license, and a photo ID. Talk-in on 147.210(+). For reservations and info, call *Larry Hendrix WB0OYU, (417) 782-5848 eves.*, or *Andy Gabbert KA0TUD, (417) 673-8371.* Address mail order requests for tickets to *ATTN: HAMFEST '95, Joplin ARC, P.O. Box 2983, Joplin MO 64803.* Must be received by Apr. 1st.

PORTLAND, ME The Portland (Maine) Amateur Wireless Assn. will sponsor a Hamfest and Electronics Flea Market, at the Univ. of Southern Maine, Sullivan Gymnasium, on Falmouth St. Doors open 8 AM-1 PM. Set-up 6:30 AM-8 AM. VE Exams 11 AM. Talk-in on 146.73/.13. Contact *Marty Feeney K1OYB, (207) 772-1682.*

WEST ORANGE, NJ A Hamfest will be held by the Irvington-Roseland AC, 8 AM-2 PM, at West Orange H.S., 600 Pleasant Valley Way. Set-up 6:30 AM. Talk-in on W2QR Rptr. 147.415/146.415; 146.520 simplex. Call *Jim Howe N2TDI,* or *Liz Howe N2WGH,* at *(201) 402-6066.*

APR 9

FRAMINGHAM, MA The Framingham ARA will hold its Spring Flea Market and VE Exams at Framingham H.S., A St. Doors open 9 AM for early bird buyers and 10 AM to all buyers. Set-up starts at 8 AM. To reserve tables, contact *Lew Nyman K1AZE, (508) 879-7456.* Send check payable to *FARA, P.O. Box 3005, Framingham MA 01701.* Talk-in on 147.15 Rptr.

RALEIGH, NC The Raleigh ARS will present its 23rd Hamfest/Computer Fair

in the Jim Graham Bldg., NCS Fairgrounds, 8 AM-4 PM. ARRL, MARS, ARES, NTS, DX, and more. Pre-reg. VE Exams/AA4MY, *(919) 847-8512.* Hamfest contact: *Rollin Ransom NF4P, 1421 Parks Vill. Rd., Zebulon NC 27597. Tel. (919) 269-4406.* Talk-in on 146.04/.64.

ROCKFORD, IL An Electronics Expo & Ham Fest will be held 8 AM-1:30 PM by the Rockford ARA. Set-up 5 AM. Location: Rockford Metro Centre, 300 Elm St. Talk-in on 146.01/.61. VE Exams. Flea Market. Ham Gear. Computers, Software. Electronics Commercial Booths. Write to *RARA, P.O. Box 8465, Rockford IL 61126,* or call *Wayne or Fay, (815) 397-6027.*

APR 15

GOOCHLAND, VA The 3rd annual S.M.A.R.T. Swapfest will be held at Goochland County Fairgrounds, RT 522 & 632, 8 AM-3 PM. VE Exams at Noon. Talk-In on 53.06(-) and 147.27(+). Contact *Buddy Travis KA4NNN, (703) 894-0406.* Sponsor: Six Meter A.R. Team.

MUSKEGON, MI The Muskegon County ARES and RACES organization will conduct a HAMFEST and VE Exams at the Pulaski Lodge, 871 Pulaski, off Henry St., 8 AM-2 PM. Talk-in on 146.82 (-). Contact *Greg Hoffman N8RXB, P.O. Box 5313, North Muskegon MI 49445. Tel. (616) 759-8786.*

APR 16

CAMBRIDGE, MA The MIT Electronics Research Soc., the MIT Radio Soc., and the Harvard Wireless Club will hold a Flea Market 9 AM-2 PM at Albany and Main St. Set-up at 7 AM. For info and reservations call *(617) 253-3776.* Mail advance reservations before the 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 pl 2A, W1XM/Rptr.

APR 22

CLARKSTON, WA The 5th Annual Lewis-Clark Hamfest/Computer Fair will be held 8 AM-4 PM at Walla Walla Comm. College (Clarkston Center Campus), West End Bridge St. Flea Market, Seminars, VE Exams. Contact *Ken Anderson KB7IAW, 840 Grelle Dr., Lewiston ID 83501. Tel. (208) 743-9569 days;* or *(208) 743-1074 eves.* Talk-in on 146.36/.96.

TALLADEGA, AL The Talladega RAC will present their "TRACFEST" at the Nat'l Guard Armory. Doors open at 9 AM. VE Exams 10:30 AM. Flea Market. Contact *JT Martin, 4181 Allison Mill Rd., Talladega AL 35160. Tel. (205) 362-0478;* or call *Linda Pettis, (205) 362-5212.*

APR 23

BOOTHWYN, PA The Penn-Del ARC will hold their annual Hamfest 8 AM-2 PM at the Nur Temple on Route 13 in New Castle DE. Setup at 6 AM. Talk-in on 147.225(-) or 224.220/Rptr. Tables by reservation only, with payment to *Penn-Del Hamfest 95, P.O. Box 1964, Boothwyn PA 19061.* VE Exams; registration 9 AM. ARRL Forum 11 AM. Contact *Hal Frantz, (302) 798-7270.*

PITTSFIELD, MA The Northern Berkshire ARC will hold an indoor-outdoor Hamfest/Flea Market at Taconic H.S., Valentine Rd., 8 AM-2 PM. Setup 7 AM. VE Exams 9:30 AM, walk-ins ok. Talk-in on 146.91. Contact *Chuck Lowery NZ1Z, (413) 447-8377.*

SULLIVAN, IL A Hamfest will be held by the Moultrie A.R. Klub at the Moultrie/Douglas County Fairgrounds (near the Arthur H.S.) In Arthur IL. Setup Sat., Apr. 22nd Noon-4 PM; Sun., 6 AM-8 AM. Payment for Flea Market tables must be received in advance. Send reservations to *M.A.R.K., P.O. Box 91, Lovington IL 61937;* or call *Ralph Zancha WC9V, (217) 873-5287, eves./wkends.* VE Exams by pre-reg. only, 9 AM-Noon. Deadline Apr. 18th. Talk-in on 146.055/.655 and 449.275/444.275.

APR 28

KETTERING, OH The Southwest Ohio Chapter of the Quarter Century Wireless Assn. will hold its 1995 Annual Banquet at Alex's Continental Restaurant. C.O.D. bar at 7 PM; Banquet at 7:30 PM. Program: "Keys to the Success of the Wright Brothers." Reservation deadline Apr 26th. QCWA membership not a requirement. For tickets ($15.00 ea.) make check payable to *Robert L. Dingle, Treas. Chapter 9,* and mail to *1117 Big Hill Rd., Kettering OH 45429-1201.*

APR 30

SACRAMENTO, CA The Student ARC of Calif. State U.-Sacramento will sponsor a Swapmeet on the campus located at US 50 and Howe Ave., 7 AM-Noon. Setup at 6 AM. Talk-in on 145.230 (-dup PL 162.2). For info call *Gary Webbenhurst KC6URB, (916) 381-6602 eves.*

MAY 6

DULUTH, MN The Arrowhead RAC will hold it's annual Swapfest 9 AM-2 PM at the Multi Purpose Bldg. at the Head Of The Lake Fairgrounds, 4700 So. Tower Ave. (HWY 35), in Superior Wisconsin. Ham and Computer Gear. Talk-in on 146.34/.94 MHz. For info or dealer/vendor space, contact *George Mead KA0BUM, 4152 Ugstad Rd., Duluth MN 55811-3620. Tel. (218) 729-6882.*

GREENVILLE, SC The Blue Ridge ARS, Inc. will hold their Hamfest at the Anderson County Fairgrounds, 8 AM-5 PM. Walk-in VE Exams at 12 Noon at Anderson College. Talk-in on 146.01/.61 or 146.22/.82. Contact *Jeff WA4EFT* or *Kay Borke KE4NHX at (803) 967-3284* or e-mail to *borke@aol.com,* or mail to *403 Aster Dr., Simpsonville SC 29681.*

OWEGO, NY Southern Tier ARC will hold the Southern Tier Hamfest 8 AM-4 PM at Marvin Park Fairgrounds, Rte. 17C and Exit 64. They will also host their 36th annual Banquet. VE Exams, Seminars, ARRL Forum, Flea Markets, and more. Talk-in on 146.16/.76 or 146.52/.52. Contact *STARC, P.O. Box*

7082, Endicott NY 13761-7082.

MAY 6-7

ABILENE, TX The Key City ARC will sponsor the ARRL West Texas Section Conv. and Hamfest at the Abilene Civic Center from 8 AM-5 PM Sat., and from 9 AM-2 PM Sun. VE Exams. Pre-reg. for tables before May 2nd. Talk-in on 146.160/.760. Contact *Peg Richard KA4UPA, 1442 Lakeside Dr., Abilene TX 79602. Tel. (915) 672-8889.*

MAY 7

BEMIDJI, MN The Paul Bunyan ARC of Bemidji will hold its annual Hamfest 8 AM-3:30 PM at the Bemidji Eagles Club. VE Exams: Contact *Gurnee Bridgmen W9NT, (218) 243-2002.* Flea Market: Contact *Dave Peterson N0QHL, (218) 751-2314* or *George Welte N0WBU, (218) 751-2931.* Talk-in on 146.13/.73.

WARMINSTER, PA The 21st annual Hamfest of the Warminster ARC will be held at the Middletown Grange Fairgrounds, Penns Park Rd., Wrightstown PA. Setup at 6 AM. Open to the public at 7 AM. Talk-in on 147.69/.09 Rptr. and 146.52 simplex. VE Exams at 11 AM. Pre-reg. at 10:30 AM; bring original and copy of present licence and/or certificates of successful completion (if any), two forms of ID, and $5.95 exam fee. Novice class exams are free. Contact *Woody Woodside N6XES, 665 St. Davids Ave., Warminster PA 18974. Tel. (215) 672-8482, 9 AM-9 PM.*

YONKERS, NY A Giant Electronic Flea Market will be held at Lincoln H.S., Kneeland Ave., 9 AM-3 PM. Setups at 7 AM. Sponsor: Metro 70cm Network. VE Exams. For registrations, call *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 440.425 MHz PL 156.7; 223.760 MHz PL 67.0; 146.910 Hz; and 443.350 MHz PL 156.7. Mail paid reservations to *Metro 70 CM Network, 53 Hayward St., Yonkers NY 10704.*

SPECIAL EVENT STATIONS

APR 6-7

DANBURY, CT The 1995 Connecticut QSO Party will be sponsored by the Candlewood ARA, 2000Z May 6th-2000Z May 7th, with a rest period 0400Z-1200Z. CW: 40 kHz up from lower band edges; Novices 25 kHz up from low end. Phone: 1.860, 3.915, 7.280, 14.280, 21.380, 28.380. VHF: 50.150, 144.200, 146.580. For operating rules write with SASE to *CARA, P.O. Box 3441, Danbury CT 06813-3441, USA.*

APR 8-9

CALIFORNIA D.O.T. As part of the Dept. of Transportation's Centennial (1895-1995) events, volunteer members of Headquarters and the 12 District Caltrans Auxiliary Radio System (CARS) Stations, using various call signs, will be operating from 1600Z-0100Z Apr. 8-9. Operations will be in the General portion of the 10, 15, 20, and 75m bands and Novice/General of the 40m band. 2 meter voice contacts on 146.52 simplex, and packet on 145.05 MHz. A commemorative QSL card, with special postal stamp cancellation will be available for contacts made. For info, call *Carol Duiay N6WCV, (916) 654-8884.*

APR 12-13 & 15

HYDE PARK, NY The Franklin D. Roosevelt Presidential Library, in commemoration of the 50th Anniversary of the death of President Roosevelt, is pleased to announce that the Poughkeepsie ARC will set up a working internat'l radio station and historical exhibit at the presidential library in Hyde Park NY. Operations will commence on Wed. Apr. 12th at 1300Z and continue until Apr. 13th at 0100Z. Operations will also be on Apr. 15th 1300Z-2100Z. Station W2CVT is planning to operate on or near the following frequencies (MHz): 7.045, 7.175, 14.045, 14.245, 21.045, 21.310, 146.550, and on the YCCC Packet Cluster. For a certificate and QSL, SASE to *Herbert Sweet, 6 Covey Rd., Hyde Park NY 12538, USA.*

APR 17

SOMERSET, PA The Somerset County ARC will operate Station NJ3T from the Somerset County PA Courthouse, in celebration of the founding of Somerset County 200 years ago. Operations will be from 10 AM-5 PM. Listen for them on the lower 50 kHz of the General class phone bands on 40m 10 AM-1 PM; and 20m 1 PM-5 PM; also 14.105 Packet the entire time. For a QSL card, send QSL and SASE to *James Crowley NJ3T, RD. 5, Somerset PA 15501, USA.*

APR 21-22

KIMBERLING CITY, MO The Kimberling ARC will operate NQ0G 1600Z-2100Z on the lower portions of the 10, 20, and 40m bands. Their CW station will be on 14030-40 and 7125-50 Apr. 21st and 22nd, to celebrate the Inauguration of Kenny Rogers SHOWBOAT, the "Branson Belle." For a certificate, send an SASE to *KARC, P.O. Box 1171, Kimberling City MO 65686, USA.*

APR 22

BELLEVUE, NE The Bellevue ARC will operate W0WYV from 1100Z-2300Z to celebrate the 35th Anniversary of the founding of the Club. SSB operation will be in the lower phone portion of the General 40, 20, and 17m bands, and if propagation permits, in the Novice portion of the 10m phone subband. CW operation will be in the Novice portion of the 40m band. For an unfolded certificate, send your QSL card with contact number and a large 9" x 12" SASE, to *Bellevue ARC, c/o Larry Bailey W0PYA, 1110 Lincoln Rd., Bellevue NE 68005, USA.*

CORWALL, ENGLAND In celebration of Marconi's birthday, the Cornish RAC will sponser over 25 SE Stations representing the locations of early Marconi experiments and transmitting stations, including: CT1TGM, DA0IMD, EI2IMD, EI4IMD, and many more. There will be a certificate for working 12 stations. For more details, contact *G4USB@GB4AKE.#44.GBR.EU* or the *Cornish R.A.C., Box 100, Truro TR1 1RX, Cornwall, England.*

APR 22-23

TULSA, OK The Tulsa ARC will sponsor the Route 66 QSO Party by operating Station W5OK in celebration of the heritage of Route 66. Operation will be from Ollie's Restaurant, the site of the first oil well in Tulsa. W5OK will operate 1800Z Apr. 22nd-1800Z Apr. 23rd. Phone: lower 50 kHz of the General 15, 20, 40, and 80m subbands and the Novice 10m subband. There will also be a 2m SSB station. CW: lower 25 kHz of the General 20, 40, and 80m subbands and the Novice 15m subband. For a certificate, send QSL and a 9" x 12" SASE to *Tulsa ARC, P.O. Box 4283, Tulsa OK 74159, USA.*

APR 28-29

THOMASVILLE, GA Station W4UCJ will be operated by the Thomasville ARC, 1700Z-2300Z Apr. 28th, and 1100Z-2000Z Apr. 29th, to commemorate the 74th annual Rose Festival. Operation will be in the lower portion of the General 80, 40, 20, and 15m phone subbands, and the Novice 10m phone subband. For a certificate, send QSL and a 9" x 12" SASE to *TARC/Rose Festival Station, P.O. Box 251, Thomasville GA 31799, USA.*

APR 28-30

DAYTON, OH Special Event Station W8BI/8 will operate from the Dayton Hamvention Flea Market. Operating hours are: Fri., Apr. 28th, 1300 UTC-2300 UTC; Sat., Apr. 29th, 1300 UTC-2200 UTC; Sun., Apr. 30th, 1300 UTC-1700 UTC. Operation will usually be in the General and Novice phone and CW bands, frequencies as band conditions dictate. W8BI/8 QSL's Hams and SWL's 100%. Send a business-size SASE to *W8BI/8, P.O. Box 44, Dayton OH 45401-0044, USA;* or via the bureau.

MAY 6-7

FRAMINGHAM, MA The Framingham ARA will host the 1995 Mass QSO Party 1800Z Sat., May 6th-0400Z Sun., May 7th; and 1100Z-2100Z Sun., May 7th. Frequencies: Any authorized amateur band except 10, 18, and 24 MHz. CW: 1810, 3550, 7050, 14050, 21050 and 28050. SSB: 1850, 3890, 7290, 14270, 21390, 28390. Novice: 3705, 7130, 21130 and 28130. For full copy of QSO Party rules, send an SASE to *FARA, P.O. Box 3005, Framingham MA 01701, USA.* Packet address *KA1USL@K1UGM* or e-mail *baymw@aol.com).*

MAY 8

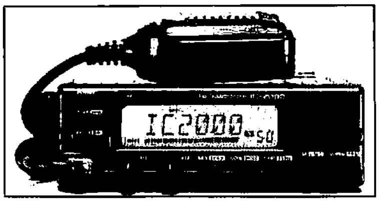
SAN FRANCISCO, CA The USS Pampanito, a World War II Balao class submarine, now a Nat'l. Historic Landmark permanently moored in San Francisco, will be the site of a Special Event Station commemorating the 50th Anniversary of VE Day. The call used for the event will be KM6TN/NJVT. NJVT was the radio call assigned to the Pampanito during her years of active service. Personalized certificates will be sent to all confirmed contacts. Operations will be in the lower portion of the General class phone bands, 0000Z-2359Z. The radio crew of the Pampanito will appreciate receiving QSL cards. Mailing instructions will accompany your certificate.

NEW PRODUCTS

Number 20 on your Feedback card

Compiled by Charles Warrington WA1RZW

ICOM



Icom has introduced the IC-2000H superior wideband 2 meter mobile featuring clear, crisp reception designed specifically to deal with cross modulation interference. The IC-2000H employs a tracking tuning system with high quality RF bandpass filters to improve image rejection and intermodulation characteristics. Now you can persue your hobby more easily in high RF environments.

Each of the 50 memories can be programmed with a six-character name. This allows you to instantly recognize the frequency by name, which eliminates confusion and mistakes. Two scratch pad memories and two scan edge memories are also available. With 50 watts of output you can easily work distant repeaters. The power level can also be adjusted to 10 or 5 watts for closer stations.

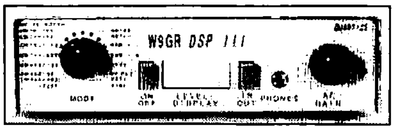
The IC-2000H has many more advanced features. Optional features include a UT-55 alpha message pager, UT-85 tone scanner, UT-101 code squelch/pager and UT-85 tone squelch/pocket beeper.

The suggested retail price for the IC-2000H is $430. For more information visit your favorite dealer or contact *Icom America, Inc., 2380-116th Ave. N.E., Bellevue, WA 98004; (206) 454-8155.* Or circle Reader Service No. 201.

QUANTICS

Quantics has introduced a low cost digital signal processor (DSP) kit for amateur use: the DSP-3. This kit incorporates many suggestions and requests made by users of the original W9GR DSP-1 kit. The popular DSP-1 has been built by thousands of amateurs.

The new DSP-3 kit has 18 DSP functions selectable by a rotary switch, including various combinations of noise (QRN) reduction and heterodyne removal (automatic notch filtering), a DTMF tone decoder with memory, seven tunable CW filters, and various filters for FSK, SSTV, and narrow SSB. A 13-bit converter chip provides the wide dynamic range necessary to filter out weak signals amidst strong QRM.



The DSP-3 kit is priced at $149, and the optional metal cabinet is $19. (California residents add sales tax.) Shipping and handling is $7 in the USA and Canada. For more information contact *Quantics, P.O. Box 2163, Nevada City, CA 95959-2163.* Or circle Reader Service No. 204.

S & S CABLE

Amateurs who like to make their own wire antennas can really appreciate a high quality copper wire that is so flexible you could use it to lace your shoes. S & S Cable has introduced this new antenna wire, designed specifically for high efficiency and ease of installation. This #12 gauge pure copper 413-strand "rope lay" is essentially wire rope specially made for extreme flexibility and resistance to kinking.

This new product offers lower resistance, larger skin surface area, and greater mechanical strength than all the standard wire previously offered. Pure copper will never rust and is nearly impervious to extreme weather. The 413-strand rope lay cannot kink and stretches only 0.2% under a 150 LB test, which would cause only a 2.77" change in a 133' 80 meter dipole, or a 6 kHz change in resonance.

To receive a free sample of the #12 gauge, 413-strand wire rope antenna wire, send an SASE with two units of postage to the address shown. For more information contact *S & S Cable Co., 9010 Forbes Ave., Northridge, CA 91343; (818) 995-0803.* Or circle Reader Service No. 207.

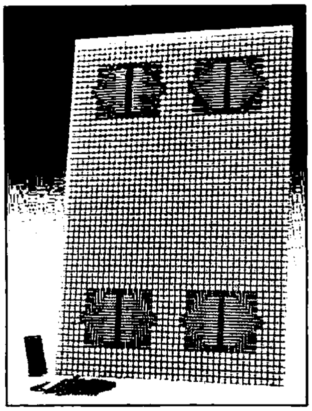
CONNECT SYSTEMS

Connect Systems has unveiled a new model communications decoder which decodes and displays 50 CTCSS codes, 104 DCS codes and all 16 DTMF digits. Model CD-2 can be used in conjunction with scanners, communication receivers, and service monitors to decode the on-the-air communications codes.

In addition to the data on the LED panel, all decoded data is available on the RS-232 serial port. An optional PC compatible software applications program (CD-2P) allows you to view all decoded data on your computer and also acquire time, dates, and hits per CTCSS or DCS code plus usage graphs. DTMF characters are decoded in strings up to 128 characters in length.

For more information contact *Connect Systems, Inc., 2259 Portola Road, Ventura, CA 93003.* Or circle Reader Service No. 208.

ECODE SYSTEMS



Surfboard is a unique surface mount prototyping board being introduced by ECode Systems. Surfboards offer variable size SIOC pads for design and prototyping flexibility. The unique pad layout allows easy and reliable mounting of both wide (400 mil) and narrow (300 mil) body SIOC styles while accommodating up to 32 pins.

The 100 mil matrix of 80 mil squares is specifically designed to permit chip resistors, capacitors, inductors, SOT style semiconductors and even DIP packages to be mounted with ease.

Surfboard is made in the USA to exacting standards and utilizes the highest quality components such as FR4 (Fiberglas epoxy laminate) and solder plating over 1-ounce copper on both sides. Single units are priced at $19.95 with quantity discounts available. For more information contact *ECode Systems, Inc., 7050 North Wilder Road, Phoenix, AZ 85021; (602) 870-8063, FAX (602) 371-8736.* Or circle Reader Service No. 202.

SIRIO

Sirio Antenna of Milan, Italy—long known throughout Europe for its fine communications antennas, is now being introduced to the North American market by Electronic Distributors. With a very wide range of antenna products for the radio amateur as well as for virtually every radio service, this manufacturer is renowned for excellent engineering, high caliber construction, and attention to detail.

A full-color brochure is now available. For more information please visit your favorite dealer or contact *EDCO, 325 Mill Street NE, Vienna, VA 22180; (703) 938-8105, FAX (703) 938-4525.* Or circle Reader Service No. 205.

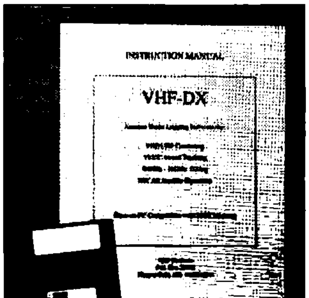
CONTACT EAST

The new 1995 catalog is now available free from Contact East, featuring test equipment, tools, and supplies. This 144-page issue is packed with hundreds of new test instruments and tools for amateurs and others. Featured are quality products from brand name manufacturers for testing, repairing, and assembling electronic equipment.

Product highlights include new DMMs and accessories, certification for Fluke multimeters, soldering tools, custom tool kits, EPROM programmers power supplies, ELF meters, adhesives, hand tools, workbenches, and much more.

All products are fully guaranteed and orders placed by 4 PM are shipped by 5 PM. To receive your free catalog contact *Contact East, Inc., 355 Willow Street South, North Andover, MA 01845-5995; (508) 682-2000.* Or circle Reader Service No. 203.

VHF PRODUCTS



If you are planning to participate in an upcoming VHF contest, a logging program designed specifically for the unique requirements of VHF/UHF operation is now available from VHF Products. "VHF-DX" provides logging and scoring functions for the ARRL VHF/UHF contests, including the Spring Sprints. The program identifies new grids, dupe checks, logs rovers, displays QSO and grid count by band (50 MHz to 10 GHz), and has real time scoring. After the contest, the complete log entry and summary sheet are automatically generated to a disk file or hard copy, ready to submit.

VHF-DX runs on PC compatibles with 512K and includes a program disk and printed instruction manual. The price is $10.95 plus $1 for shipping (please specify type of disk). For more information contact *VHF Products, P.O. Box 23391, Chagrin Falls, OH 44023; (216) 543-2748.* Or circle Reader Service No. 206.

BARTER 'N' BUY

Number 21 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to sand to those interested?

Send your ads and payment to the Joyce Bocash, *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the June 1995 classified ad section is April 13, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

INCREDIBLE DX SITE for individual or ham club in Northern Virginia. **ONE OF A KIND!!** Fully furnished 2 bedroom cabin with 40' x 15' deck overlooking Shenandoah Valley. 3.5 acres **MOL** on top **REPEAT** on top of Blue Ridge at 2100'. Convenient, easy access, one hour west of DC & Dulles Airport. Half down, will finance balance. Serious Buyers only. **DICK KD4ATB**, 813-347-5444. BNB235

ROMAC RADIO EXCHANGE, a revolutionary new computer on-line service for buying and selling amateur radio equipment. Why wait for weeks or even months to sell and buy equipment. Call today! Free until July 1, 1995. (300 to 14400 baud. 8/N/1.) 1-810-486-4878. BNB260

KPC-3 TERMINAL PROGRAM User friendly, split screen, scrollback buffer, save & send files easily. User programmable auto connect. SASE for **FREE** details. $29.95. **ComTreK**, Box 4101, Concord NH 03302-4101. BNB271

QRP TRANSMITTERS—3 watt kits and asembled models for 20M, 30M, or 40M. Fun to build! 2 stamps for "milliwater" infor. **Techsonic**, 32F Plymouth Park, Conshohocken, PA 19428. BNB280

Continued on page 90

PROPAGATION

Number 22 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

April doesn't appear to offer many really Good (G) days for DX propagation. The best days are likely to be the 9th through 11th, the 20th through 22nd, and the 26th through 28th. The worst days are likely to occur during the first week of the month (see the calendar below). Be particularly alert for some geo-physical upsets around the 1st, 2nd and 3rd. "Keep your powder dry!"

Some recent information from NOAA/SESC (thanks, K6QT) indicates that the bottom of present Sunspot Cycle 22 could occur as early as December 1995 or January 1996 . . . almost a full year earlier than might otherwise be expected. Unexpectedly, as this is written (January), the Solar Flux has jumped up from the low '80s to the mid '90s, but such high numbers are not likely to be sustained. For best results, use the best antennas you can afford, and get used to listening for *weak* DX signals.

10 and 12 Meters

Occasional F2 openings to the Southern Hemisphere during daylight hours. The bands close at sunset.

15 and 17 Meters

Consistent openings to Africa and Latin America, and short skip to about 1,000 miles during daylight. Bands close at sunset or shortly after.

20 Meters

Your best band for DX to all areas of the world between sunrise and well past sunset, and short skip to 2,000 miles during daylight hours.

30 and 40 Meters

Good DX from slightly after local sunset to just before local sunrise. Signals from the east peak between sunset and midnight, and from all other areas between midnight and sunrise. Daytime short skip to 1,000 miles, and nighttime skip to 2,500 miles.

80 and 160 Meters

Good DX from sunset to sunrise on nights of low atmospheric noise, and skip to 2,000 miles or so. Requires vertical transmitting antennas and horizontal (preferably Beverage) antennas for best results on receiving. Little, if any, daylight activity on 160, but some on 80 meters.

Final comments require me to warn of possibly violent weather and other geophysical occurrences centered around the 9th and 10th, and again around the 16th and 17th. Hang on to your hats! As always, check WWV at 18 minutes after any hour for the latest updates on propagation. See you here next month.

APRIL 1995

SUN	MON	TUE	WED	THU	FRI	SAT
						1 P
2 P	3 P-F	4 F-P	5 P	6 P	7 P-F	8 F
9 F-G	10 G	11 G-F	12 F	13 F	14 F	15 F
16 F	17 F	18 F	19 F	20 F-G	21 G	22 G-F
23 F	24 F	25 F	26 F-G	27 G	28 G-F	29 F
30 F						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
AGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

73 Amateur Radio Today

MAY 1995
ISSUE # 416
USA $2.95
CANADA $3.95
A WGI Publication
International Edition

HOME-BREWING HEAVEN!
A Builder's Guide to the Universe

Simple Emergency Power Controller

Easy HF Loop Antenna

Lose Those Pesky Wall Warts

Tracking Down a Phony SOS

More 73 Reviews

Comet Mobile HF Antenna
Trident Wide-Range Receiver
Oak Hills Explorer
Alinco 6 Meter Mobile

THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

MANAGING EDITOR
Hope Cumer

SENIOR/TECHNICAL EDITORS
Charles Warrington WA1RZW
Mike Nugent WB8GLQ

EDITORIAL ASSOCIATE
Joyce Sawtelle

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KOOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Charles Warrington WA1RZW

GRAPHIC DESIGN
Suzanne Cote

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

GRAPHICS MANAGER/PAGINATION
Linda Drew

CIRCULATION
To subscribe: 1-800-677-8838

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article
Back issues: $4.00 each

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N Peterborough, NH 03458

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

May 1995
Issue #416

TABLE OF CONTENTS

FEATURES

REVIEWS

What are Carole Perry WB2MGP and Captain Curtis Carver N2XJF doing on the grounds of West Point? And what's that antenna in the background? Turn to page 72 to find out.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: Jason Auvenshine N7UGP, Bob Buchanan KA7CC, and Jerry Clark K7KZ home in on what later turned out to be a hoax "emergency" signal. Turn to page 52, "Homing In," for details. (Photo by David Sanders, The Arizona Daily Star. *Reprinted with permission.)*

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts: Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

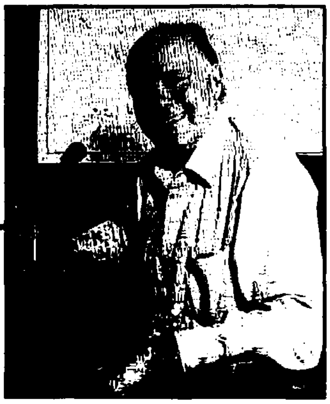
73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents ©1995 by Wayne Green Inc. No part of this publication may be reproduced without written permission of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693

Contract: Uh-oh! By letting your gaze wander to this paragraph, you've just become legally and morally bound to help save the new Senior/Technical Editor's butt. Luckily for you, it won't be difficult. Just send interesting ham-related photos for our Photo Search, as described in QRX (September 1994, p. 8). It's a win-lose situation—your photo might become a cover, and I might be forced to keep this crummy job.—Nuge WB8GLQ

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1



Preferring the Snail

Former *73* Editor Bill Brown picked up a bunch of stuff about me from the Internet. It came at a fortuitous time. Synchronicity at work. Oh, you haven't read *Synchronicity* by David Peat? Tsk.

I've been under increasing pressure to climb aboard the Internet and at least enjoy the wonders of E-mail. I've been resisting. You can see the heel marks as my so-called friends have been dragging me kicking and screaming into the information age.

I keep telling 'em that I've been there and done that. Well, I have. And, as I read the pile of culch Bill pulled off the Internet, my RAM was refreshed. Oh yes, that's why I have been fighting E-mail.

RTTY, the First E-Mail

It all started back in 1948 when I was working as chief cameraman for WPIX in New York. That's the Daily News TV station. They had no objection to my setting up my 2m rig on top of the News Building, one of the more modest skyscrapers on 42nd Street in midtown. I found an empty room next to the TV transmitter, with a door opening out onto the roof. I bought a 16-element beam from Bill Hoisington W2BAV and set it up on a surplus prop-pitch motor out on a narrow ledge. I was using an SCR-522 I'd converted to 2m. It had an 832 in the final and put out a healthy signal.

The ledge was a little tricky. I wanted to get my beam out in the clear as much as I could, and the best spot for it had me going from the roof area out on a foot-wide ledge with a 30-floor drop on one side and a 15-floor drop on the other. I felt like I was walking a tightrope when I looked down. It was not a good place to be when there was any wind at all.

Wow, was I able to work out from that fantastic location! I had no problem working all of Connecticut and New Jersey. But I wondered what on earth those strange beedle-beedle sounds were I kept hearing up on 147.96 MHz. It turned out to be ham Teletype, which was being promoted by John Williams W2BFD from his radio-TV repair shop in Woodside, Queens. After a couple of visits to John I was busy building my own RTTY terminal. It had around 20 or so 6SN7GTs and not only translated the two tones into printing with a Model 12 Teletype machine, but also had automatic almost everything. It shut down when the signal stopped. It would turn on automatically and copy any message on the RTTY channel. It would even turn on my rig and confirm the receipt of a message with a beep-beep.

I helped John set up the RTTY repeater and this made it so every RTTY operator in greater New York could keep in touch without having to swing their beams.

A Lot Like 75m

But after awhile I discovered what I'd noticed on 75m back in 1946, when I used to talk just about every night with W1MLJ in Barre (VT), W1IF in Peabody (MA), and W1KPL in Jaffrey (NH). It wasn't long before we were just rag-chewing and joking, and little of any importance was being communicated. I wasn't either learning or teaching anything. Finally, it occurred to me, hey, why am I doing this? Why am I wasting my time for hours a day like this?

The excitement of RTTY communications was enough for a while. Then I began to notice that the benefits to me were fading. I enjoyed the technical challenge. I had great fun getting everything working. I had a ball up on 11 meters pioneering RTTY, back when that was an anything-goes ham band . . . which we lost because we didn't use it enough. We weren't permitted to use frequency-shift on the low bands then. I went on 80m with make-break keying instead of frequency-shift, and soon had made the first coast-to-coast contact with Bob Weilbrecht W6NRM, a deaf ham. All this was fun, but the content of the messages I was getting was the same old stuff, with a high boring quotient.

I wanted to help make my transmissions interesting, so I wrote little articles, stored them on punched tape and fed them through my tape reader at 60 wpm to anyone interested. It was a lot like a BBS. That tape experience turned out to be very helpful a couple years later when a RTTY ham gave me an opportunity to work on a Guggenheim Grant on a color organ for the Guggenheim Museum on Fifth Avenue. The color organ programs were all run by punched tape.

My adventure with RTTY turned out to be serendipitous again, for it was through Graham Claytor, one of the NYC RTTYers, that I got the job as Secretary of the Music Research Foundation, where I had the opportunity to work with several of the top psychiatrists, psychologists, and psychoanalysts on the use of music in psychotherapy. I ended up writing a book, *Music For Your Moods*, which the Foundation published. My first book. Just the other day I was looking through a box of badges and buttons and came across the medal I won in high school for music recognition. I also came across a medal from the ARRL for winning the 1947 15th International DX Competition. I'll bet they've stopped sending out medals to contest winners.

Losing My Buttons

I was thinking of adding those medals to the pins and buttons on the *73* baseball cap I've been wearing at hamfests, but then I remembered that no one has ever asked what all the pins are. Well, since nobody has ever noticed, why bother? After all, they're all just my own personal memories. My WWII submarine combat pin, pins and buttons from my high school, college, electronics school, QCWA, OOTC, ARRL 50 years, Boy Scouts, Porsche Club of America, PS199 in Brooklyn, SCCA Competition Driver, 1939 World's Fair, Skin Diver, USS Drum SSN677, Deputy Sheriff Harris County, ITU Conference in Geneva, Erasmus Hall Choral Club, AOPA, Nurburg Ring Racetrack, Royal Jordanian Amateur Radio Society, an old 220 Use It Or Lose It button, and so on. Just an old man's memories and of no interest to anyone else. I'll put the hat up in the attic.

The color organ project was due to another RTTYer. I started a RTTY newsletter in 1951 while I was working at WXEL in Cleveland as a TV director. Well, they had a mimeo machine. That quickly put me in touch with all the other RTTYers around the country. And that eventually got me a RTTY column in *CQ*, which led to my being the editor, which got me to start *73*, after being fired from *CQ*. That's a story I tell every now and then, so I won't refresh your memory with it again.

No Big Bang?

I mentioned Bill Hoisington's beam. After I started *73* Bill moved to Peterborough and wrote endless simple construction articles for the magazine as K1CLL. He was endlessly creative up until his death a few years ago. My recent brush with cosmology, the result of my interest in cold fusion, has brought be up against some most interesting people, some of whom are not at all convinced about that Big Bang theory. Bill wasn't either. He proposed that light just naturally runs down. I published an article by him on the subject.

Well, one problem with cold fusion is that currently-held theories of physics say it's impossible. To true believers in these theories, every one of the experimenters who have been getting anomalous heat are wrong. They must all somehow have made experimental errors. The experimenters, some of whom are getting thousands of times more heat than the "accepted" theory permits, say it's about time to rethink theory.

Troublemakers point out that when light goes through water or glass, it slows down. Well, we know that space isn't empty. It's got a lot of hydrogen and helium, plus debris from past novas. Then there's the 90% or so of invisible something (dark matter) which is exerting a powerful gravitational influence on the galaxies we can see. It might be that all this stuff tends to slow down light and that the red-shift is due to that instead of all the other galaxies flying away from us. That would give us a steady-state universe and would fit in better with calculations in the biological and other fields.

This cold fusion stuff sure is making trouble, and it isn't going away. I'm writing this the day after a one-day cold fusion conference at MIT where I saw some fascinating demonstrations. For instance, one chap explained how to build a gun capable of shooting fairly large projectiles into outer space just by passing an electric current through a small amount of plain water. He showed a quarter-inch metal plate with a hole caused by a blast of water being shot through it.

Well, you're probably not interested in all that stuff. If you're an average ham, you'll be more interested to know that it's snowing right now and that on my morning jog I saw the tracks of several deer, some rabbits, and a bunch of squirrels crossing the road. The snow, which took its sweet time to come, is beautiful.

I was most pleased to meet a couple of hams at the conference who blamed me for their interest in cold fusion. Well, as they pointed out, I was right about the development of cellular phones and computers, so perhaps I'm right again. I haven't seen anything yet that's not encouraging. But then, these new technologies always take a lot longer than I expect to develop. It took microcomputers 20 years to get where I thought they would be in 10. As you watch the computer ads on TV, just remember that old Uncle Wayne tried hard to get hams involved back in 1975. Many of those who did made millions.

One of the MIT undergrads at the cold fusion conference showed us a little glass with a couple of inches of water (40 ml) and a small palladium rod he had been sticking into the glass. He showed us the curves of the excess heat he'd been getting. It took him awhile to get everything right, but now

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Lionel Barley KBØPZD, Wichita KS Well, I made it back into ham radio. I held WBOHRQ as a General Class operator in the late 1970s. Then I ended up with one of those new-fangled "high-tech/high-pay" careers in the early 1980s. Folks said I needed another college degree in order to be qualified lor the work I was already doing, so I went to night school . . . letting my ticket lapse along the way . . . and got a degree in computer science. By that lime technology had already made that career obsolete, and I embarked on another "high-tech/high-pay" career. Now, wouldn't you know, that ol' technology just kept a-changing. Scratch "high-tech/high-pay" career number two. Oh Indeed, mainframes were just a bit clunky compared to PCs.

Wayne, now I'm on "high-tech-sans-high-pay" career number three. And I am starting to see this one going away. I've been working in industrial and aerospace manufacturing for 20 years. The new PC software coming out is eliminating any need for advanced mathematics, or even to have much of any experience in machining processes. The smarts are in the box rather than in the head of an analyst/programmer. Maybe il I went into business for myself on the side . . . .

Since the company I work for (days) has cut my hours so much, I have had the time lo go back and work on getting another ham ticket. I'm back again as a General Class operator, still enjoying CW on low bands just as much as ever. This time I am going after that Advanced license. Heck, I may even get gutsy and try for my Extra. Love those ripplin' ditsl

Scott Schram KN4L, Birmingham AL Wayne, your March 1995 editorial about hamming being irrelevant in the face of the Internet is right on target. I'll bet most hams don't realize the amazing things that are already being done . . . I'd like to tell you about one night's activity.

Last night I connected to the Internet by calling a service provider on a 14,400 bps modem (soon to be 28,800 bps . . . and not long after that using ISDN at 128,000 bps). I used Telnet to connect to a "Moo," a text-based virtual reality, and I met some of my friends that I've talked to regularly over the last year. They are located around the U.S., two in Holland, one in Norway, two in Canada, and one in Auslralia. About 10 of us carried on a discussion about a programming project that we're mutually Interested in. The connection is QRM-free, and very close to 100% reliable, 24 hours a day . . . which makes HF hamming into something of a quaint novelty.

After that, I enjoyed a game of "Scrabble" moderated by a distant computer, and my competitors were several thousand miles away. Speaking of games . . . well, virtual reality is here. I then logged onto a Mulli-User Dungeon (MUD). Teamed with some of my editorial friends, and wielding our swords, we proceeded to dispatch a number of foul creatures and villains.

Clearly, the Internet will do far more to promote international goodwill than we could ever hope to accomplish with QRM-packed meaningless exchanges of signal reports.

The free exchange of information boggles the mind. I loaded my World Wide Web (WWW) browser, which is a hypertext browser. I just click on the highlighted words, and I'm off looking at the next interesting thing. It's not unlike using the help system in Microsoft Windows, except that the pages you view come from far away.

So I browsed a bit, and came upon a page where someone had hooked a video camera up outside their building in Stockholm, Sweden. I transferred a live photo ol the early-morning street there to my computer. Another novelty: I checked the temperature of some guy's hot tub. and the sensor on the Diet Coke can in his refrigerator.

Then I settled down for some serious browsing. I downloaded the entire text of the book *Phantom of the Opera* from the Gutenberg project. I browsed the Louvre museum, and viewed Images of Impressionist paintings . . . looked into some protein research articles at Johns Hopkins University . . . listened to some sound clips of Broadway musicals, and checked ticket schedules. With 1.8 million WWW pages, It's already the most fabulous automated library you've ever seen, and it's only beginning to hint at what will eventually be done.

Wayne, I'm a supporter of ham radio . . . every member of my family is a ham—my wife Ruthie KD4BOW, and daughters Crystie KD4WZY and Celsie KD4ZGP. We use 2 meters and 440 as a conventional way to keep in touch. However, ham radio will change as a result of this revolution.

Jim Robb, Danville KS Wayne, I just finished your editorial in the February 1995 issue of *73 Amateur Radio Today*. What a story! I've been "hooked" by the electronics bug ever since a lady gave me a copy ol *Boys Life* magazine, on my paper route, 1955. A little article about shortwave listening and a line drawing, 4 x 4 Inches, changed my life forever.

I could write on for pages: science fairs, college electronic lab assistance, Texas Instruments, Army airborne radar and GCA, cable TV franchises, computer software development, a computer hardware and service business. Now we are working on a matching grant, for funding, to study some possibly overlooked parameters of tornadoes, which will lead to a small receiver for residents in rural areas to provide automatic warning and also direction and movement, toward or away, from their location.

All of the above because of people like *you*. A big thanks from all of us.

Jerry R. Dunham N7MUX (DU4MUX), Rodeo CA Wayne, I've been reading *73* for several years, since before getting a license, and really did not understand what you were always going on about, as I had never, until last week, operated in the U.S. I have made my home in the Philippines for the last nine years and have only been licensed for six.

For me every contact was Interesting, most were DX, and none were the trash you have described. Last week that changed. Since being discharged from the Navy 26 years ago I have been a merchant seaman—an engineer, not a radio officer. Last year I took a job on a coastwise oil tanker engaged in the U.S. West Coast trade. Upon my return from vacation this time I decided to buy a TS-50S and do a little maritime mobiling. The only thing I can say is that if I were ever to live in the U.S. again I think I would fast lose interest in the hobby.

Keep up the good work with *73* and *Radio Fun*. I take my old copies back with me to Legazpi for the few hams there.

Vincent Dolva WØGP, Hawley MN Wayne, I have just finished reading your editorial in the March 1995 Issue of *73* magazine. I always look forward to them in each issue. I agree with so much in your writings. This one was especially well done.

On page 73 you struck a chord with me when you mentioned the sorry lot of QSL cards that will be there when one's time comes. Perhaps an incident I experienced a couple of weeks ago may be of interest.

A former high school classmate of '36 sent me a letter in which was enclosed one of my QSL cards dating back to April of 1934. Shades of the past!

She had been browsing through some tables at a Viking Fest in Decorah, Iowa, and one had a collection of postcards from all over the United States. She asked if any were from Hawley, Minnesota, and one of the two was mine!

In pencil I had written on the margin way back then that I had received my license in January. My receiver was a '24 detector and a '27 amplifier. My transmitter was a pair of '45s. Not mentioned was that my antenna was a 160 meter counterpoise.

I follow your writings with interest. I have wondered about sperm damage. I have wondered about electric fields. However, having made my living most of my years as an electronic technician, exposed to very high magnetic fields from high-powered radar sites, I have not noticed Ill effects myself. But of course this doesn't mean there aren't any for others, or even for me.

My ham radio interests are more in the area of construction and experimenting. I work only a weekly schedule with an old friend from grade school days via 20 meter CW. I am into packet and other related fields like weather scan, etc.

Thank you very much for your continued efforts toward amateur radio. Keep up the good work.

Alfred L. Pedneau Sr. K5HKG, Alexandria LA Wayne, you are correct in the way that we need younger operators. I very seldom miss the local club meeting on the first Monday of the month. Very seldom do we have any young people there. Most kids these days want to play on a computer or be given something for free. No one gave me a free Novice license In the summer of 1956, and no one has given me anything free since then. I believe you have to work for everything you get.

Keep up the good work, and keep calling a spade a spade. Nowadays someone has to.

Al—There you go blaming the kids for not being interested in amateur radio. That's like a manufacturer blaming the public for not buying his product. Al, you have to sell any product or service and we hams are not *selling. Amateur radio today is an almost unknown hobby. When I lecture college kids on entrepreneurialism I ask for a show of hands of how many know what ham radio is. I get maybe three or four out of a couple hundred, and I've been lecturing at Yale, Rensselaer Polytechnic Institute, Case Western, Boston University, Babson College, and a bunch of others. It isn't the kids' fault, it's the ARRL's for doing its best to keep ham radio a secret hobby for retired old white men, as represented by the League's board which you and the rest of us have elected. And re-elected. And then re-elected again . . . Wayne*

Del Harper KC4ZQP, Portland OR Wayne, I have been a subscriber to *73 Amateur Radio Today* tor several years now and I musl admit that I find your attitude towards life and creating accomplishments refreshing. I totally agree with you that people should take responsibility for their actions and quit blaming everyone and everything else for their current stale ol being. I believe that I am the sum of all the choices that I have made during my life to date, and if I have a problem with where I am at or what I am doing, I am the one that I should talk to in order to fix it. I am proud of my accomplishments as well as my screw-ups.

Once again, thank you for all the enjoyable hours learning about the hobby and the field of electronics that you have provided me since I have become a member of the amateur radio community.

QRX . . .

FCC May Change RFI Rules

The Federal Communications Commission has proposed permitting manufacturers and suppliers of computers and computer peripherals to market their equipment without having to apply for equipment certification. The requirement for FCC approval would be dropped under ET Docket 95-19.

Currently, these devices must conform to FCC certification to ensure that they do not cause interference to radio services, including the ham bands. This certification involves specific measurement data and a detailed product description to be submitted to the Commission's laboratory for review and approval.

The process can take a month or more. The industry estimates that eliminating the wait could save the computer industry some 250 million dollars per year. The FCC described the current regulations as burdensome to manufacturers and says this new procedure would align FCC requirements for personal computers with those "used successfully in other parts of the world."

The streamlined new process would be based on the manufacturer's or supplier's Declaration of Conformity. *TNX ARRL; Florida Skip, March, 1995.*

Bright Future

If you've been procrastinating about upgrading your license class. this will make you really feel like a loser. Pictured on this page is *nine-year-old* Samantha Sanford AA3JS. Samantha passed her Novice exam at age eight on May 3, 1994, gave up TV for the summer and fall, then passed her Extra exam on December 21, 1994, just eight months later!

Samantha enjoys making new friends on CW and SSB. and she loves to ragchew with all the local club members of the South Hills Amateur Radio Club, of which she was voted Junior Select Person for the 1995 term. She is often the net controller for the weekly 2 meter net. She has also been active in Field Day activities and has set up a ham radio exhibit at her elementary school.

Samantha aspires toward the science or engineering disciplines, sparked by her involvement in amateur radio. She offers the following advice for those thinking about taking an amateur radio exam: Study, study, study; practice, practice. practice; then have fun. fun, fun! *TNX Robert Sanford AA3FI.*

Vanity Callsigns On The Way

On February 1, 1995, the FCC released the full text of the Report and Order covering how amateurs may obtain the callsigns of their choice. The system, outlined in last month's *QRX* (April, 1995, page 8), consisting of four "gates," is at the heart of the Commission's plan. The full text is several pages long, and places emphasis on the fair and equitable distribution of vanity calls.

Priority is given to to close relatives of deceased amateurs to obtain their old signs, followed by Extra Class, Advanced Class, and finally, to any licensee. As expected, the fee is set at $70 for ten years. Announcement of when you may apply for a vanity call will be made by public notice, so keep your eye on this space in the next couple of months. The system should kick in as soon as the Form 610-V is available. *TNX W5YI Report, February 15, 1995.*

Photo A. Stefan Leca YO8RCW at the Empire State Building's Observatory in New York City. (Photo by George Pataki WB2AQC.)

Photo B. Samantha L. Sanford AA3JS (age 9).

Romeo Zulu Whiskey to QSY

After two years as our Senior/Technical Editor, Charlie Warrington WA1RZW has *seen* the light, and is leaving the staff of *73* and *Radio Fun.* That's because Charlie is moving up the frequency spectrum to *write about* light—he'll be documenting products as a Technical Writer for a leading manufacturer of reflectance and laser devices. Thanks, Charlie, for your dedication and creative energy over the past couple of years!

Mike Nugent WB8GLQ is taking over the position of Senior/Technical Editor here, and we all want to wish Nuge the very best. Nuge will draw on his previous experience as Consulting Editor at *73* back in 1990 and 1991. He has also worked on the publications *Portable 100*, *PICO*, and *pb: Your Powerbook Home Companion.* Welcome aboard Nuge!

More Space Hams

Two more US astronauts have joined the ranks of amateur radio, according to the ARRL, as reported in the *X-mitter.* Both are expected to fly aboard the Space Shuttle Endeavour during an upcoming launch.

Pilot William G. Gregory is now licensed as KC5MGA and Payload Commander Tamara G. Jernigan is now KC5MGF. Both sat for exams on January 19, and were issued callsigns on January 25, thanks to electronic filing with the FCC—a new feature for the Commission. *TNX Penn Wireless Association's X-mitter; ARRL.*

Long Walk

Romanian travelers Lavina Tatar and Stefan Leca YO8RCW are touring the world on foot! The pair left Romania on their "Journey for Peace" August 17, 1992, and have walked across 24 countries so far, wearing out 106 pairs of shoes. On route, Stefan (see photo) has used 16 different callsigns, including TAØRCW, JYØRCW, A45RCW, 7Z1RCW, 9K2RCW—well, you get the idea.

So far they have been received by King Hussein of Jordan JY1, Sultan Qaboos of Oman A45AA, Prince Talal bin Abdulaziz of Saudi Arabia HZ1TA, Prince Titiphan of Thiland HS1LY, and many others. The total trip is expected to end in Romania, taking a total of three years. *TNX George Pataki WB2AQC.*

Builder's Guide to the Universe

A beginner's guide to home-brewing.

by Mike Bryce WB8VGE

There's no question about it. I like to build electronic kits. From the old Heathkits to the baggie of part kits. I do like the smell of molten solder. But, there's more to ham radio than just stuffing a PC board with pieces parts. I also enjoy designing my own gear from the ground floor. If nothing else, it's a learning experience. I may not know everything there is to know about power MOSFETs, but I sure can tell you how *not* to use them. Ah yes, the utter shock of seeing bits of TO-220 case parts heading your way after the explosion. Great fun!

To me, that's part of our past as radio hams, building and designing our own equipment. I also enjoy the challenge of taking a project from just an idea to a working unit.

"To me, that's part of our past as radio hams, building and designing our own equipment. I also enjoy the challenge of taking a project from just an idea to a working unit."

A Widget

What's it going to be? That's not as easy as it sounds. I've built many a project and not had the slightest idea of what it's supposed to do. I don't have the talent to design a new multiband PLL computer-controlled rig. So, I don't try. On the other hand, I love to play with a new IC that will do strange and wonderful things with just two capacitors and a diode. There's nothing quite like the feeling of conquest I get from making a micro-powered op amp with a 2.5-volt reference diode do its thing.

I try to avoid re-inventing the wheel. Let's face it, there are only so many ways to build an antenna tuner or a field-strength meter. However, you can improve on most designs you may run across or add in features you want.

As a general rule I set many years ago, I try not to get involved with complex mechanical projects. I tried to build a power amplifier for 2 meters using a single high-power tube. The amplifier required a vast array of pipes, pumps, seals, motors and other goodies. After months of working on this project, I tracked down most of the problem to a pair of bad seals. There's not much you can do with a pair of bad seals, so I had them shot. That's why i keep my distance on overly complex mechanical projects.

Design your project around easy-to-find parts. Although the project may be a one-time shot, perhaps someone in the radio club you belong to wants to duplicate it. That surplus warp plasma coil you picked up at the Dayton Hamvention two years ago may not be easy to find. If nothing else, you may need a replacement part for your own use. Perhaps your little project may turn out to be really something special; then by all means you'll need a solid source for all the parts. Who knows, you may want to write up the project and send it to *73* magazine for publication. A project with a parts list naming several sources will always be ahead of the rest on the editor's table. Part sourcing and the ability to duplicate the project should be high on your design list.

Unless the project uses one or two ICs and a handful of parts, it's PC board time. Designing one isn't hard to do, and there are several computer programs made just for laying out PC boards. I find laying out PC boards to be a kind of brain health food for me.

First Steps

You need some sort of a plan for your project. Even God had a plan, and you need one too. It does not have to be fancy, just some thoughts on paper will do. I prefer to use the backs of crane safety report forms myself. They're just the right size for drafting out a circuit.

Next, you'll need to specify how you're going to proceed with your project. I usually start with a block diagram on paper, then expand the blocks by adding bits and pieces of the circuit. We're still talking about just ideas, with no actual circuits being laid out. If I think I will need an NPN switching transistor, I'll draw out the basic idea and then add in the required support parts later.

As the blocks become full of ideas, it's time to do some mental circuit checking. Now is the time to stare into space while your wife yells at you for staying too late at the last hamfest. All this time, while you're catching hell, you're working on the how and why of your project. When things quiet down, smile and say, "You're right dear," and go back for some more circuit design!

After I've worked out most of the circuit in my head, it's time to start building up the circuit in real time. I use a prototype board for all my logic circuits. Perf-board is great stuff, but not for trying out a new digital design. It's a hassle to solder in a part, test, remove and then solder in a new part. If nothing else, the parts you end up removing usually go to the trash can. The prototype board is the only way to go when it comes to digital or analog circuits. It's the fastest way to make changes without heating up the soldering iron.

I don't use this method for testing out RF designs. Instead, I use a hunk of double-sided PC board material. I solder in the parts in a skywire/ugly building fashion. After a few weeks of work, you can really go through the solder this way.

Build in stages. If you're working on a small receiver, then start with one section. Design that section and test it before moving on to the next. You might want to start with the VFO, then the buffers and BFO. After these stages are working, design, test, and refine the audio section and power supply. I use a bench power supply to operate my unit under design. It's much faster that way, since I don't need to rebuild this basic building block.

As I work my way through the project, I usually find my thinking is 180 degrees out of phase. In other words, it don't work. It

never seems to make a bit of sense to me why a circuit would work perfectly on paper, only to do the damnedest things in real life. This brings up an important step in building your own gear—the paper work.

Keep Track of Your Paper Work

It's true! You're really not done with any project until the paper work is finished. I have a hard time with this myself. Once the project starts taking form, it's so easy to lose track of the changes made to it. I end up with several dozen versions of the project, having no idea what version worked and what one produced smoke. I've now gotten into the habit of writing down the date and version number someplace on the schematic. This way, I have some idea of what I've been working on.

I start with a large sheet of drawing paper. I build the circuit based on the outline and block diagrams on my cheat sheets. As I assemble the circuit, I test and confirm its operation, then I transfer the details onto this sheet.

After I have the circuit working on the prototype board, I tear it all down and start to rebuild the circuit once more. But this time I use the schematic I created during the testing phase. It goes without saying, I usually screw up somewhere along the way and need to make changes on the schematic. Of course, changing the problem on paper still requires changing the circuit on the prototype board as well.

> ***"I get madder than a Klingon in a room full of Tribbles when I see a PC board with a zillion wires emerging from it."***

If all goes as planned, I have a working project on my hands, but I'm not done yet. There are still a few more steps required before I move on to my next idea. As I mentioned earlier, a PC board is the only way to build today. So, if I consider the project worthy of a board, I then start to lay out the basic design of the circuit, again on paper.

I usually have some idea of what and how many types of inputs and outputs the project will require. A keyer, for example, will need at least five wires to and from the PC board. My designs differ from most of the designs you may be used to, as I like to employ some sort of PC terminal block or header. I get madder than a Klingon in a room full of Tribbles when I see a PC board with a zillion wires emerging from it. A terminal block or header makes the board easy to install, use, and repair.

Perhaps the best thing to happen to PC board layout has been the computer. No more cut-and-paste with tape and donuts on plastic. Now, a computer will allow you to lay out a circuit and move one or more traces or pads in seconds. There are PC layout programs for DOS, Windows and the Macintosh. How to use these programs is a bit more than I want to get into right now, but most are easy to learn and use.

After you have your PC board laid out, it's time to make a trip to the local copy or graphic arts shop. Here, I have a larger than

one-to-one paper copy made of the artwork. A good quality copy machine that will do enlarging will work too. I have the original enlarged as big as I can to fit the paper. Many times I use the "B" size paper, or 11 x 17 inches. If I have a double-sided board, I make the top side of the board in red and the bottom in black. Again, any good copy center or graphic arts shop should be able to do this for you at a fair price.

With the enlarged PC board traces at hand, it's time to get down and dirty. You'll need a highlighter pen or two and a night of reruns on TV. The object is to follow each and every trace you made against your schematic. Check off the components on the schematic as you follow the circuit on the paper. Use the highlighter to mark sections of the PC board you've checked, and those on the schematic as well.

After you have made your corrections, it's time to burn a board. Again, that's a bit more than I want to go into right now, but enough to say it's not at all hard to do. However, I've gotten lazy in my old age, and now send the artwork out for a prototype or two to be made. I don't like to iron and the resist pens are a pain in the butt. Lucky for us, there are several companies that specialize in making PC board prototypes. FAR Circuits (18N640 Field Court, Dundee, IL 60118) will do prototypes at a fair price. Write to find out the finer details.

The price will depend on the size, amount of extras like silk-screening and solder mask, and if the board will be double-sided with plated-through holes. A recent project set me back $300 for two double-sided boards with plated-through holes. This was done by a company that makes large runs of PC boards. They did the work for me but I had to pay for it. Had I gone ahead with a run of the same boards, the cost would have been about $8 each in lots of 100. Even in short runs of 25-50 boards, the price is quite reasonable. It's now possible to have a PC board made for a club project without the club's accountant having the big one.

> ***"Why who knows, I may want to build your version of a time continuum projector for Field Day, and I'll need the plans!"***

No matter what route you take, the first board more than likely will have a bug or two. The problem is, you'll never know it unless you build the project on your new PC board! Now this is what I call fun! No matter how many hours I spend checking the paper layout of the PC board, I usually find something screwy with the final project. It may be a case of having a resistor placed too close to an IC or a terminal block hitting a regulator. Or, I've even been known to forget a VCC run to a chip or two. Again, make the necessary correction and have a second board burned. And, again, check the PC board out by building the circuit once more. This time around, everything should be as good as it's going to get.

The final part of the project is writing up some sort of instructions for the project. Do you really think you'll remember what that jumper block does three years from now? Gather all the paper work from the original block diagrams to the final PC board layout and file them away.

While this does seem to be a lot of work for a simple project, it's well worth the time and effort. The ability to reproduce the project is a must for most editors. Why who knows, I may want to build *your* version of a time continuum projector for Field Day, and I'll need the plans!

Number 5 on your Feedback card

Wart Remover

Build this easy module to eliminate unsightly wall parasites from your shack.

by Michael Bryce WB8VGE

Most of them are small, black and ugly. Every ham I know of has dozens of them sucking up juice, even when they're doing no work at all. They hide in the most out-of-the-way places, yet they're always in the way. They can suck the life right out of your standby battery banks if you're on inverter power. To top things off, they're expensive to buy if you need one. What are they? They're wall warts—small power supplies you plug into the wall outlets.

Look around your shack. How many wall warts do you have plugged in? Five, 10, or even more? They keep my inverter on all the time and, just like parasites, they suck power from the inverter even though the device they're suppose to be running is turned off.

Every time my wife wants to use an outlet, a wall wart must be removed first. Of course, she always manages to get the one attached to the backup lighting system. After replacing the batteries for that light for the last time, I came up with the "Wart Remover." This simple project will allow you to remove just about all the wall warts from your shack. You can build your own Wart Remover for about $40 or so. It's easy to build and requires no special test gear to adjust.

The basic module will replace up to four wall warts, and you can add on a second module if you want to remove more. If you only have three or less (are you kidding?), you need only build the circuit for your needs. The Wart Remover will replace up to 3 amps worth of wall warts. An extended PC board will hold up to eight regulators, and you can piggyback another extended board for a total of 16 regulators.

A Closer Look at Wall Warts

Most wall warts are nothing more than a small transformer, diodes, and a filter capacitor. In fact, if you rip one apart, you'll find perhaps one diode, maybe two, and a small filter capacitor. They have no active devices inside, such as regulators or transistors. They're sealed up in plastic, making repair almost impossible. When they go bad, you get a new one. With guts like this, most wall warts have very bad voltage regulation and leave plenty of ripple on the DC they do supply. Some wall warts supply only low voltage AC to their loads.

Looking around my shack, the wall warts I have come in several different flavors. They're either in 6-volt DC or 9-volt DC, with some AC-only ones thrown in for good measure. I use my main 12-volt battery bank for all my 12-volt needs, thus I have no 12-volt wall warts.

The Wart Remover

It's simplicity itself. I wanted a project that everyone could build. So, using off-the-shelf parts that are easy to find was my first goal. It also had to be easy to adjust. In keeping with ham radio tradition, it had to be cheap, too.

What I came up with is a stock LM317 regulator circuit. The circuit is a standard constant voltage type. I figured it would be easier on everyone to go constant voltage instead of constant current because of the zillions of different loads wall warts operate.

A PC board is used to speed up the project. In fact, there are two PC boards. The

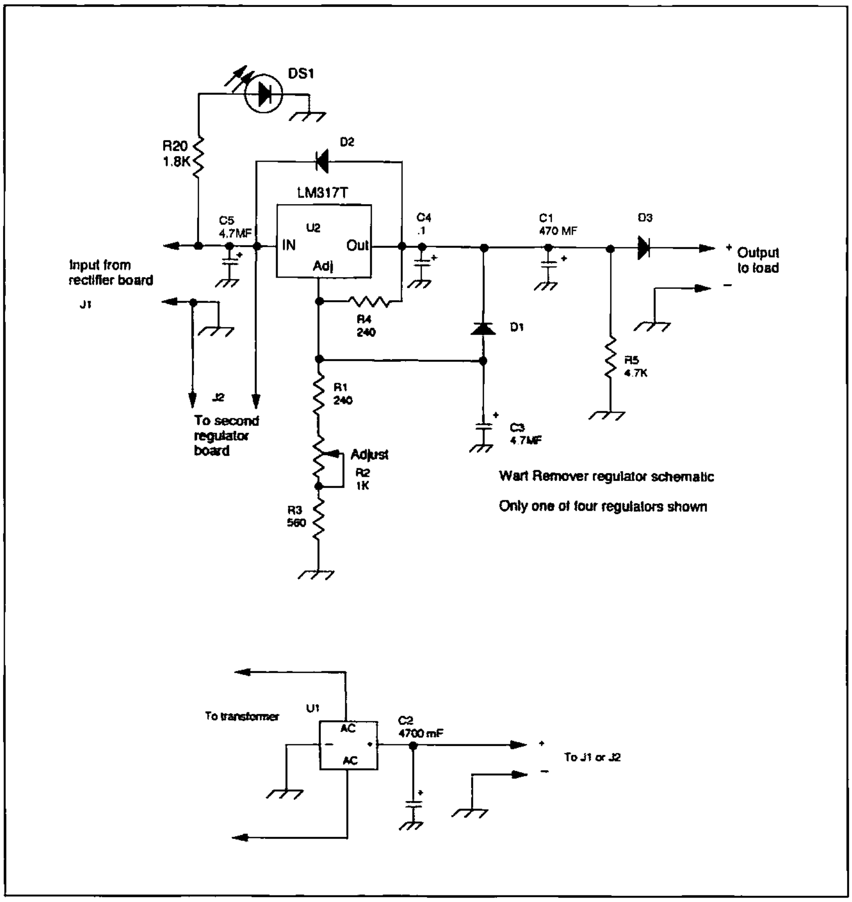


Figure 1. Wart Remover schematic diagram.

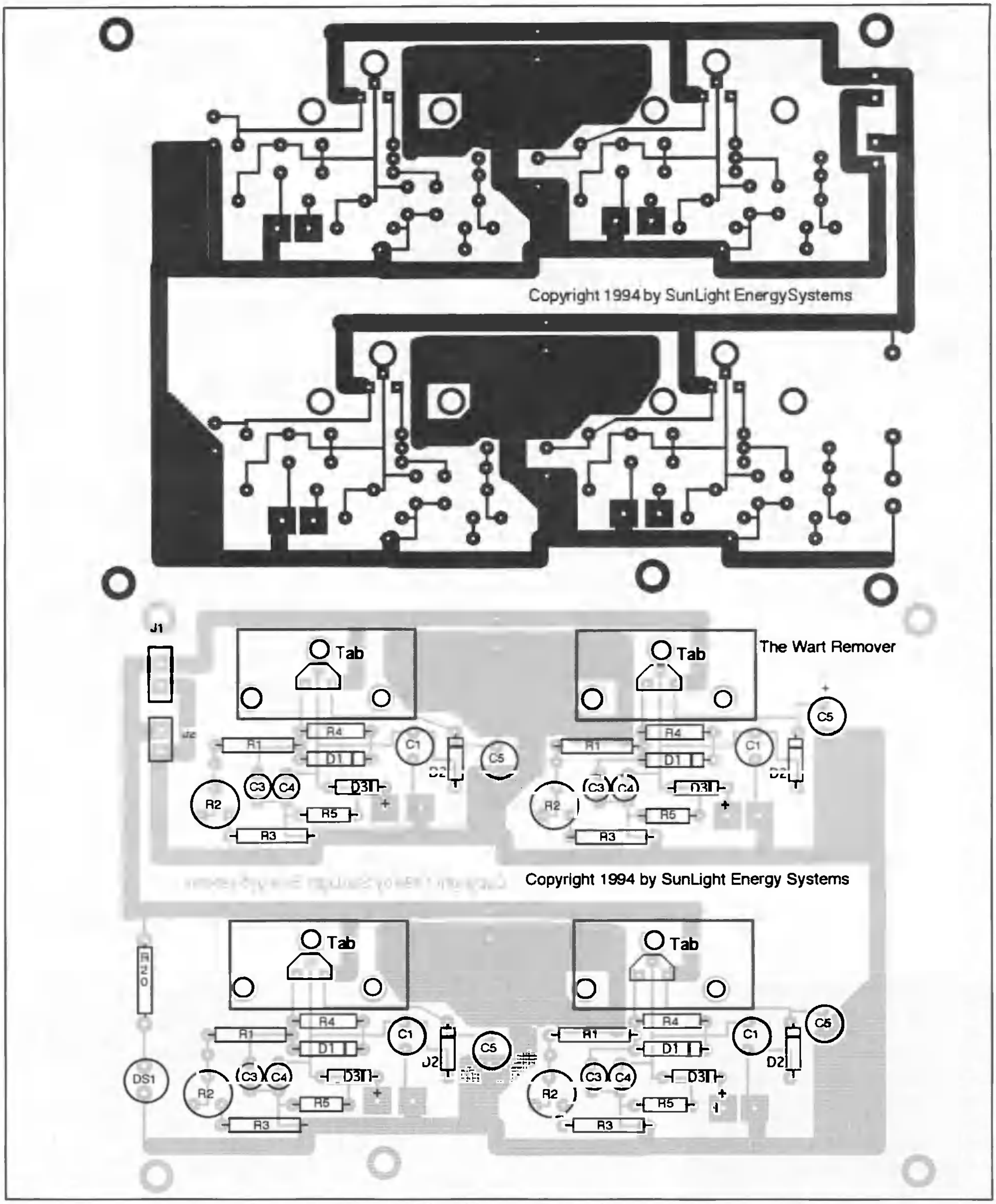


Figure 2. PC board layout and parts placement.

full-wave diode rectifier and filter capacitor mount on one board. This board plugs into the main regulator board holding the LM317 regulators. You can add on a second, or third, regulator board by stacking them. A cable with a plug-on .156 center connects all the boards together. As I mentioned earlier, there is an extended PC board which will hold eight of the LM317 regulators.

Each regulator board will hold four LM317 regulators. Each regulator has its own voltage adjust pot. You can build all four regulators, or only one, adding more on as your needs grow. Since each regulator can supply up to 1 amp of current, the transformer and rectifier/filter board should be able to handle the required current. It's quite possible to have up to 16 amps of current if you add on two extended regulator boards and fully load them down. However, we're kinda lucky on this as the loads wall warts

supply are usually very small. The dead wall warts in my pile had currents ranging from a low of 30 mA to a high of 800 mA, with just about everything else in between. In my first Wart Remover, I settled for a 2-amp rating. That's enough for a 500 mA load on all four regulators.

How It Works

The power transformer supplies the diode/filter board with about 14 volts. Since I did not want to power any of my 12-volt loads from the Wart Remover, the lower secondary voltage from the transformer will help to keep the heat dissipation down on the regulators.

The full-wave bridge rectifier and filter capacitor supplies the regulator board with a source of DC. On the regulator board, resistor R20 limits the current flowing into the "power on" LED. This LED glows whenever the Wart Remover is plugged into the AC mains. There is no "on/off" switch.

"Be careful when installing the many electrolytic capacitors—they must be installed correctly or you'll smell burned capacitors!"

Diodes D1 and D2 protect the LM317 from reverse voltage damage from battery-operated loads such as rechargeable lights and radios.

For clarity, only one of the regulators is shown in the schematic of the Wart Remover. Remember, there are four regulators on each regulator board.

The LM317 adjustable regulator is textbook-simple. I added a small load to each of the regulators to keep the LM317 stable under light- or no-load conditions. Each output is decoupled with a 1000 µF capacitor and a .01 capacitor. The smaller tantalum capacitors on the input and output of the LM317 keep the regulator(s) from oscillating.

Each LM317 has its own trimmer used to set the output voltage. Resistors R1 and R3 make fine voltage adjustments a bit easier with the single-turn trimmer. All the trimmers are mounted flat on the PC board so you can adjust the output voltage without standing on your head. If you stack more than one regulator board, you'll find adjusting the bottom board interesting. I have my top regulator board on a hinge so I can swing it out of the way to reach the bottom board. Really, once you set the regulators to their proper voltage, you won't need to mess with them again, unless you want to change the voltage setting.

Assembly

I highly recommend the use of the two PC boards for this project. Yes, you can use just about any method you feel comfortable with to build your own Wart Remover, but the PC board is the way to go. Both PC boards and a kit of parts are available[1].

The main regulator board and the filter/rectifier board are single-sided. A plug with .156 centers connects the filter/rectifier board to the regulator board. On each regulator board is a header, also on .156 centers, to piggyback a second or third regulator board. Remember to keep the total current within the rating of the rectifier and transformer. If you use the PC board set, you can use either plug on the regulator board. The headers have a locking tab making reverse polarity mistakes history.

To avoid confusion when stuffing the PC board, each regulator and its components repeat. For one main regulator board, there will be four R1 resistors, four C1 capacitors, four C2 capacitors, and so on. Each of the four regulators is identical in every way.

Each of the four individual LM317s has its own heat sink. You can use a small hunk of aluminum if you don't want to mess with the ones described in the Parts List. There is no need to insulate the LM317 from the heat sinks, provided each regulator has its own heat sink. A word of caution however: If you use a single long strip of aluminum to heat-sink all the LM317s at one shot, you must insulate them from the heat sink. Apply some thermal goo and fasten them down with 6-32 screws and nuts.

Be careful when installing the many electrolytic capacitors—they must be installed correctly or you'll smell burned capacitors!

I mounted the two PC boards, transformer and fuse holder on a small sheet of 1/8-inch aluminum. I believe it to be a cut-down 19-inch relay rack panel. A 1/4-inch hole drilled in each corner provides an easy method of mounting the Wart Remover to the wall. This open-air construction also helps keep the LM317s cool by providing natural convection cooling.

The rectifier/filter board has four mounting holes, one at each corner. Or, you can turn the board over and use the hole in the bridge rectifier to hold the assembly. This way, the aluminum mounting becomes the heat sink for the diode assembly. Use some thermal goop here, too.

Safety first! Be sure you include a fuse in the primary of the power transformer. I use a 3-amp fast-blow fuse in an enclosed fuse holder. Again, safety first—use plenty of tape or heat-shrink tubing to fully protect yourself and others from any exposed 110 AC points. My Wart Remover is bolted onto the wall. If you elect this method, too, some sort of safety cage would be a great idea, especially if you have children in the house.

The transformer is not at all critical. You can use just about any 12-volt secondary at whatever current it can deliver. Remember to add up the total current you're going to be using when looking for a transformer. Good sources for transformers are surplus electronic dealers, hamfests, or your buddy's junk box. I built a Wart Remover using a transformer from a defunct VCR! Worked great! In a pinch, Radio Shack carries several that will fit the bill quite nicely.

Of course, you'll need the proper-fitting plug for each load. You could steal the plug, cord and all, from the wall wart, but don't. Instead, wrap it up nicely and put it away in the original box it came from. This way you'll know what it's for a year from now. Radio Shack carries an impressive collection of coaxial jacks. Mouser Electronics also carries dozens of coaxial plugs.

Setup Adjustments

All you really need to do is probe the output of one regulator at a time and set its output voltage. The only precaution here is to set the output of the individual regulator for the voltage required *by the load* and not the open circuit voltage of the wall wart! I have one wall wart listed at 9 volts DC but open circuit voltage read almost 17 volts! If you want to operate your tape recorder and it requires 6 volts, set one of the regulators for 6 volts. It's a good idea to mark what regulator is running what load so you can refer back to it if you need to at a later date.

Adjustment

Plug the transformer's secondary into the rectifier/filter board. Plug the transformer into the AC outlet. Check for about +14 volts at the output of the rectifier board[2]. Unplug the transformer from the AC mains. Now, plug the regulator board into the filter/rectifier board. You can use either plug on the regulator board. Put power to the transformer and you should see the LED glow. Now, all you have to do is set the output of the first LM317 to whatever voltage you desire by adjusting the trimmer associated with that LM317. Then, move on to the next regulator until you have them all set.

The final step is to solder the proper connectors to the PC board. Be sure you have observed the correct polarity of your load! You don't want to cook it because you hooked it up backwards. It would be a very good idea to clearly mark each cable coming from the Wart Remover so you know what is what next month.

Last Words and Precautions

Every wall wart load I've owned states something about voiding the warranty if the device is operated from something other than the wall transformer supplied. If you have second thoughts about powering your $500 walkthing with the Wart Remover, then don't.

If your load recharges its own internal batteries (rechargeable flashlights, HTs, or hand drills), proceed with caution. Many of these loads count on the wimpy regulation of the wall wart to keep from overcharging the batteries.

There's the possibility of cross-wiring some devices, depending on how they are wired internally. I've not had this happen, but there may be times when you would

connect a tape recorder to a radio via a patch cord. If the radio chassis is at "+" voltage and the recorder is at "-" voltage, things would become interesting. I've not had this happen as most of the "+" ground devices are insulated from the common ground. Check to be sure before assuming everything is at the same potential.

You can supply the regulator board directly from a 12-volt supply such as your main rig's power supply. When you power up the rig, all the external loads will also come up. You can also use a 12-volt battery to power the Wart Remover, too. Don't forget to install a fuse in the supply line in either case.

If you need some low voltage AC, steal it from the rectifier/filter board. There are two pads on the board just for that purpose. Remember to keep track of the total current being pulled from the transformer.

Even though there is not enough voltage for the regulators to provide +12 volts, you can still delete a 12-volt wall wart if the load current is not too high. You should be able to set one LM317 at 12 volts and draw 100 mA or so from it before the voltage drops too low and the IC falls out of regulation[3].

If you need to set the output of the regulator to a real low DC voltage, say, 3 volts, you may need to play with the values of the resistors in the voltage divider.

I don't know if adding a fuse for each output would be worth the time and effort. An LM317 will shut down during a short circuit condition. The LM317 will also shut down if it overheats.

Last Page

I hope you have as much fun as I did in designing the Wart Remover. It's fast, simple, and fun to build. Even easier to use! Of course, now that you have all those open wall outlets, think of all the new rigs you can get! ■

Parts List

R1	240	
R2	1k trimmer	Mouser #531-PTC10V-1K
R3	560	
R4	240	
R5	4.7k	
R20	1.8k	
D2	1N4002	
D3	1N4002	
D4	1N4002	
C1	470 mF	
C3	4.7 mF	
C4	.1 mF	
C5	4.7 mF	
U1	LM317T adjustable regulator	Mouser #511-LM317T
BR1	6-amp bridge diode	Mouser #333-BR61
DS1	Red LED	Junkbox
Heat sink		Mouser #567-7-371-BA
J1	2-position .156 terminal housing	Mouser #538-09-50-3021
J2	2-position .156 terminal housing	Mouser #538-09-50-3021
J3	4-position .156 terminal housing	Mouser #538-09-50-3041
J4	4-position .156 terminal housing	Mouser #538-09-50-3041
Friction lock PC headers		Mouser #538-26-48-1246 or DigiKey #WM4602-ND
Crimp terminal for terminal housing		Mouser #538-08-0106

Mouser Electronics: 1-800-346-6873
Digikey Electronics: 1-800-344-4539

Notes:

1. A complete set of PC boards, the filter rectifier and one main regulator board, and all parts (except for the transformer), is available for $45 from SunLight Energy Systems, 2225 Mayflower NW, Massillon, OH 44647.

Board set only $15 from FAR Circuits, 18N640 Field Court, Dundee, IL 60118.

Extended regulator board $26 from FAR Circuits.

2. The actual output from the filter rectifier board will be determined by the transformer used.

3. Using a higher-voltage transformer and changing out the two resistors in the voltage divider will allow for full 1-amp current at 12 volts.

Number 6 on your Feedback card

by John R. Bolduc N1QGS

Ace Communications
10707 E. 106th Street
Fishers IN 46038
Telephone: (800) 445-7717
Fax (800) 448-1084
Price Class: $369

The Trident TR-1200 Wide-Range Monitor Scanner

Listen to the world with this compact little unit.

It's lightweight, compact, has a thousand channels, and can tune around the world. I am describing the TR-1200 model scanner from Trident. This is not just a typical police scanner—this hand-held radio will pick up all sorts of things that are of interest to the amateur. The TR-1200 covers from 500 kHz up to 1300 MHz in three different modes: AM, FM wide, and FM narrow. The modes can be selected independent of the receive frequency. Scan and search steps range from 5 kHz to 995 kHz. There are 10 memory banks with 100 channels per bank. There are also 10 search ranges that can be saved in memory. Power is provided by four supplied NiCd AA cells or a furnished 12 VDC power pack.

My first impression of this radio was, "Wow, this is light for its size." The unit tilts my postal scale at just 11 ounces without batteries, and its dimensions are just 6-3/4" by 2-3/4" by 1-1/2". The Trident TR-1200 is *very* similar to radios sold under the nameplates A.O.R., Fairmate, Camnis and Yupiteru.

My first lesson using the Trident was not to misplace the user's manual. Although programming the radio can be mastered, it takes some practice and some double-checking the manual. The TR-1200 has many bells, whistles, and various functions. However, they are not easily memorized, and having the manual handy during operation was usually necessary. After logging in on one of the more popular on-line computer services I learned that other users shared this opinion. In fact, several users of these radios have created wallet-sized and full-sized function sheets to carry with them.

So what does the TR-1200 have to offer the average ham? The Trident will tune to every amateur frequency below microwave, from the long wavelength 160 meter band at 1.800 MHz through the 1240-1300 MHz amateur band. The tuning knob on the top of the radio makes it very easy to tune up or down a few kHz at a time for fine-tuning. One drawback for the ham, however, is that single sideband mode reception is not available in this model. What this means is that below 29 MHz there is limited amateur traffic that the TR-1200 user will be able to monitor. Only traffic that is in the AM mode is intelligible. Of course, the majority of traffic here is SSB or CW. If you want to pick up SSB or CW, you either have to add a BFO or look to another radio. Trident is now offering a model that includes a BFO, by the way.

Scanning

Scan banks can be scanned individually or in groups. For example, banks 2, 3 and 4 are programmed for fire; and banks 5 and 6 for the big NASCAR race. You may certainly scan all groups at once, but this means potentially scanning through 1,000 channels.

While the casual user may have difficulty filling two or three banks of 100 channels, the seasoned scanner buff can find ways of filling 1,000 channels, although it takes some effort.

Scan Bank	Use
1	Local towns—police, fire, hospitals and local government for towns within 20 miles.
2	Fire departments low band—33 MHz and 46 MHz fire services.
3	Fire departments VHF high band—154 MHz fire services.
4	Fire departments UHF band—460-485 MHz fire service.
5	Race track frequencies.
6	Police—locals and State Police/Sheriffs for all six New England states.
7	Amateur 29 MHz and above.
8	HF/shortwave/medium wave (AM) stations.
9	Wife's favorite FM and TV station audio.
0	Research, including Federal Government and 800 MHz.

Table 1.

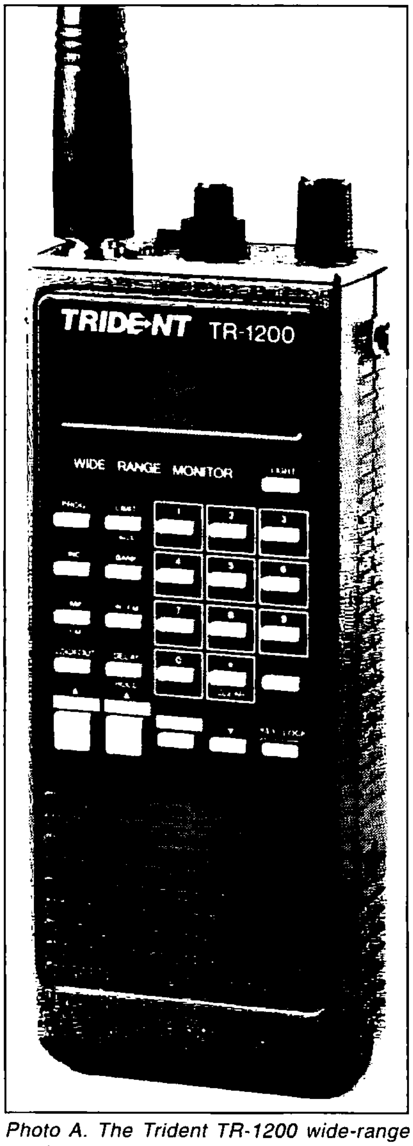


Photo A. The Trident TR-1200 wide-range monitor scanner.

Search Bank	Range	Search Step	Mode	Use
1	33.440-33.980 MHz	20 kHz	FM narrow	Low band 33 MHz fire
2	46.060-45.500 MHz	20 kHz	FM narrow	Low band 46 MHz fire
3	44.780-45.460 MHz	20 kHz	FM narrow	New Hampshire State Police
4	462.550-462.725 MHz	12.5 kHz	FM narrow	General mobile radio service (non-business)
5	146.400-147.400 MHz	15 kHz	FM narrow	2 meter amateur
6	88.100-107.900 MHz	200 kHz	FM wide	FM broadcast
7	118.000-136.000 MHz	25 kHz	AM	Commercial/private aircraft
8	225.000-400.000 MHz	50 kHz	AM	Military aircraft
9	153.770-154.445 MHz	15 kHz	FM narrow	Local fire department
0	460.025-460.500 MHz	25 kHz	FM narrow	Boston MA police

Table 2.

33.00 MHz	FM narrow	.25 µV
44.00 MHz	FM narrow	.20 µV
54.00 MHz	FM narrow	.43 µV
146.00 MHz	FM narrow	.27 µV
156.00 MHz	FM narrow	.35 µV
166.00 MHz	FM narrow	.35 µV
408 00 MHz	FM narrow	.98 µV
450.00 MHz	FM narrow	.75 uV
460.00 MHz	FM narrow	.50 µV
470.00 MHz	FM narrow	.60 µV
490.00 MHz	FM narrow	.75 µV
856.00 MHz	FM narrow	.35 µV

Table 3.

Table 1 shows how I filled the 10 banks. Not all 100 channels need to be programmed in each bank. Unprogrammed channels are not scanned.

I do not actually scan banks 8 and 9, as these services have a constant signal that would halt scanning. For these banks I use the direct access to channel feature to select the desired channel.

Search Banks can be set up slightly differently. See Table 2.

Sensitivity specs were measured on an IFR Model 500A communications analyzer. See Table 3.

Note how some frequencies are much more sensitive than others. In some areas the radio seemed hot sensitivity-wise. In other areas the radio provided less sensitivity. Actual field usage replicated bench testing. I realize that covering such an enormous chunk of frequencies is probably achieved with some compromise. However, some of the sensitivity drop-offs occurred in ranges where I find some interesting listening and researching. Hams may note the 408-450 MHz and 6 meter sensitivity as well. The scan and search rates are both approximately 20 channels per second.

The user's manual states that the supplied antenna was not intended for shortwave or broadcast band reception. I did find that many stations in the 49 meter band were still easy to hear with this rubber duck. Substituting a long piece of wire stuck in the BNC antenna jack as suggested by the user's manual provided a great number of stations for listening. This is enticing to the shortwave listener who enjoys the standard broadcast fare in the AM mode.

The user's manual is quite detailed. It appears to be written by an individual or individuals who genuinely want the user to understand how to use the radio. In some cases fewer words could have adequately described the functions. The manual I received with the radio appears to be a preliminary version, as some of the paragraphs were incomplete. *[Manufacturer's Note: This has now been corrected.]* The paper and ink used

in the printing of the manual were of low quality. After walking for about 10 seconds in a snow shower with the manual exposed, the ink on the cover and an inside page ran considerably.

Speaker Audio

As with virtually all hand-held radios, I found the speaker output to be only sufficient in situations with little or no background noise. It was inadequate in situations such as at fire scenes or driving in a car. While showing the radio around at a party, I had to pull people into a separate room to clearly hear the radio traffic. Turning the volume knob beyond two-thirds of full range didn't seem to help.

"In order to keep the comparison as fair as possible I used the supplied rubber duck antenna for both the Trident and my own scanners."

Features and Accessories

Rubber ducky antenna, which looks exactly like a Yaesu dual-band rubber ducky. This antenna performs well on VHF high band (144-174 MHz) and UHF (440-470 MHz). However, as with most rubber ducks, performance is poor on VHF low band.

Batteries—four factory-provided NiCd rechargeable cells. Their performance was fair compared with brand-name NiCds. As with all NiCds supplied with electronic gadgets, a lengthy initial charge of about 14 hours was necessary.

AC power adapter for charging and listening to radio. This performed well.

DC/car cigarette lighter plug. This performed well.

Earphone—your standard monaural earphone.

Carrying strap.

Belt clip. I did use this.

Vinyl case. The majority of the front of the case is of clear vinyl through which all keys are easy to access. The case actually took some fairly abusive treatment and came through surprisingly well.

Keys, knobs and switches.

Tuning knob placed within easy reach on top of the scanner. This is particularly useful for fine-tuning stations in bands with nonstandard channel spacing. I found the tuning knob particularly useful in the HF bands.

Keyboard lock. Located on the front panel, it has a raised lip around it. This handy button will lock all other keyboard buttons. I use this feature when I'm at a fire scene fiddling with my camera and I don't want to accidentally change the setting on the radio.

Display backlight. Pushing this button turns on the well-illuminating backlight for the display for about six seconds. I did find its usability a little irritating. I find that six seconds is not always adequate time for programming in the dark. Holding the button in will not keep the backlight illuminated. Pushing the button before the backlight goes out will extinguish the light. Having illuminated keys would be a plus.

Comparison

The Trident TR-1200 is a near clone of the A.O.R. AR1000XLT, less 800 MHz cellular radio phone coverage.

I found it necessary to evaluate the TR-1200 using two different criteria. One was using the radio by itself on a weekend stay in coastal Maine. Since this area was relatively untried turf for my monitoring, I did not have any major expectations of what I should be hearing. The TR-1200 was fun to use once all the desired frequencies were entered into the many channels and search groups. It performed admirably in the presence of my relatives, although they were a bit befuddled by the steps necessary to program the radio. I was satisfied with its ability to hear police and fire departments for 40 miles up and down the coast using just the rubber ducky. AM broadcast band reception, however, was dismal, even with a very long piece of wire as an antenna. TV and FM broadcast stations in the region all came in well. The AM civilian aircraft band did not receive much until I got within five miles of the Portland, Maine, Jetport.

At a major shopping mall I attempted to seek out the mall's security channel. Having been inside the mall, I determined that security/maintenance was using UHF handie-talkies. My confidence in my ability to program search functions without the manual was dealt a blow, as it took me a good 10 minutes of button-pushing to get things right. In less time than it took me to find the correct function key pattern I had found the Maine Mall frequency.

The second criterion I used was side-by-side comparison with three other radios I own. This was a somewhat unfair comparison, since it took three radios to compare to this one Trident. The radios I used were a Realistic 2006 base scanner, a Regency HX1000 hand-held scanner, and a Yaesu FRG-7 communications receiver. Compared to other radios I own, the TR-1200 does more than any one of them alone. However, in many cases the TR-1200's performance is less, in common coverage areas, than the other radios'. In order to keep the comparison as fair as possible I used the supplied rubber duck antenna for both the Trident and my own scanners.

Overall Impressions

It's fun to listen to, but a minor challenge to master. The biggest plus: My spouse likes to use it. My biggest dislike: It needs more scan banks, with fewer channels per bank. For the price it is tough to match the coverage of the Trident TR-1200.

Say you saw it in 73 Amateur Radio Today!

73 Review

Number 7 on your Feedback card

by Jeff M. Gold AC4HF

Oak Hills Research
20879 Madison Street
Big Rapids MI 49307
Telephone: (616) 796-1460
Price Class: $129.95

The Oak Hills Explorer Kit

Build a fun, inexpensive and high quality CW rig.

Ham radio is a great hobby. There are always new frontiers to explore and new things to learn. Of all the thrills I have had with the hobby, the greatest has been firing up a rig I built myself and then actually getting to talk to someone on it. The excitement seems to be there every time. I have many commercial and kit-built rigs on my bench. The commercial rigs seem to sit for long periods of time while the ones I have built get all the use.

I always wanted to build radios. When I was a teenager I remember dreaming about building a Heathkit. I didn't have anyone to help me get into the hobby, so the dream sat idly for years. After getting my ham license and then using commercial equipment for a year, I decided it was time to build something. By the time I got to order, Heathkit was just going out of the kit business. I was fortunate enough to have access to the Internet (worldwide network of computer networks) and posted a message that was heard around the world, asking if anyone still had an un-built HW9. I wasn't really sure what QRP was, but this was the only listing for a kit that I might be able to afford.

I finally found an un-built HW9 kit from a ham who knew a friend who had purchased a few of them at the Dayton Hamfest. I sent a money order and waited (although not too patiently.) When the kit came I unpacked it slowly and was a little overwhelmed by the number of parts. I read through the instructions in the front of the very thick manual.

"Today, I still get this excited about building kits even after building about every kit on the market."

I did manage over a long period of time to assemble all the parts very carefully. The big day finally came. Heath was very good about including a couple of pages of tests to do before you actually put any power on the kit. This can save many a project from damage. My HW9 passed all these tests, so it was time for the power-on tests and alignment procedures. I carefully hooked up the power and very nervously turned on the power supply. I almost jumped back, expecting fire and explosions. I was so happy that it didn't burn up that I let out a scream that about scared my wife and son out of their socks. Today, I still get this excited about building kits even after building about every kit on the market.

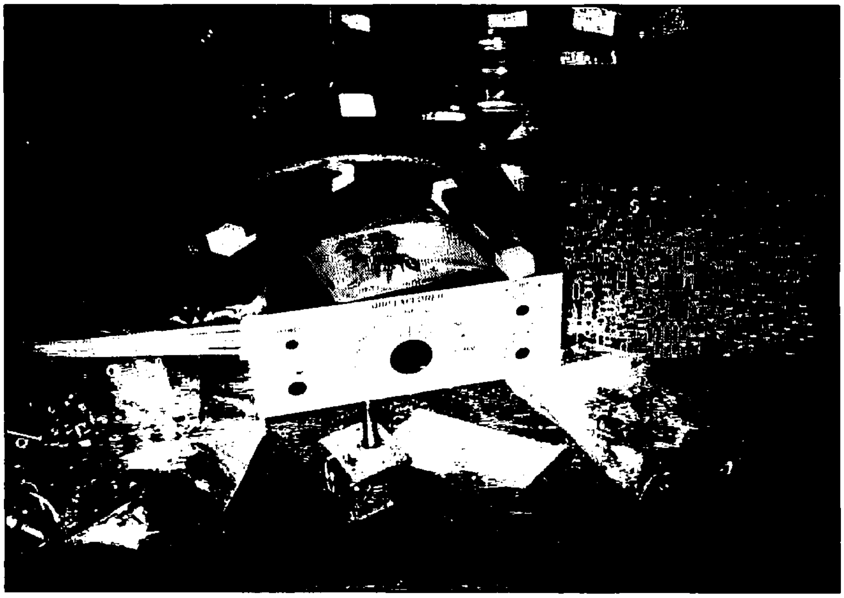


Photo A. The Explorer kit in progress.

I would not recommend a kit that is this involved for a first project. To pick a project, you need to decide whether to build a transmitter, receiver, transmitter/receiver combination or transceiver. To learn more about the way things work, you may want to start building the individual station parts and then put them together to form an operating station.

An important consideration is the type of receiver that is incorporated in the kit. The two types that are in most of the kits are Direct Conversion (DC) and Superheterodyne. The DC receivers are simpler to build but have some limitations. With a DC the receiver picks up signal energy from above and below a given frequency equally well. For instance, if you are tuning a station that is on 7.040, as you tune up the band the signal will get stronger until you reach a point where it seems to disappear. This is the center frequency or "zero beat" frequency. As you tune immediately past it the signal will once again become strong and then begin to weaken. If there is much noise on the band from other stations (QRM), the noise can seem worse than it really is. The DC receiver can also become overloaded from commercial AM broadcast stations. This doesn't mean that this type of rig can't work well, but you will need to get used to tuning in a signal using a DC receiver. An advantage of this design is that the rig can be made very small and lightweight and can be sold for a very reasonable price. If you are planning to use the rig for portable or backpacking use, this may be a good choice.

After building many kits, I recommend a good single-signal transceiver kit with a stable VFO (after your rig warms up initially it

will remain on the same frequency without drifting). The Explorer from Oak Hills Research makes an excellent beginners' project. I have had a great deal of success with Oak Hills Research kits and have built about everything they have produced.

The Oak Hills Explorer

The Explorer is a single-band superhet transceiver for 80, 40, 30 or 20 meters. Depending on the time of year or the time of the day you like to operate, any one of these bands is a good choice. Each band has a slightly different personality.

In my opinion, 20 meters is best for low-powered DXing and a little harder to rag-chew; 30 meters and 80 meters are both good rag-chewing bands; and 40 meters can have some good DX and some good rag-chewing—it's usually pretty busy and it is easy to find someone to talk to on it.

The Explorer kit has a very stable VFO circuit with a vernier dial that provides 100 kHz of coverage (50 kHz on 30m). The rig has an RIT circuit that provides +/- 1.5 kHz of range. The radio also has a four-pole crystal ladder filter, an AGC circuit, a sidetone oscillator with level control, and an excellent solid-state QSK circuit. My rig puts out a solid 3 watts of power. The rig draws 50 mA on RX and 450 mA on TX.

This kit has only one printed circuit board. It is double-sided with plated-through holes and the solder side is solder-masked to help prevent solder bridges. The two main problems new and old builders have are that they accidentally get solder on the board, causing a connection that isn't supposed to be there, or they put a part in the wrong place. The board that comes with this kit makes it easy not to get solder bridges, and the silk-screening is of such good quality that it really helps you get the parts in the right place.

The third thing that really helps eliminate building problems is the excellent, clear instructions that come with the kit. There are step-by-step instructions and very nice diagrams. There are no wire jumpers on the board, which is a nice feature. Many beginning kit builders find it hard to wind coils. All the coils come nicely pre-wound, packaged separately and clearly labeled. There were many details in this kit that made building a real pleasure.

Building the Kit

If you are a new builder there are some tips on building you should keep in mind. You should be careful when you open the box. There may be pieces or instructions that are hidden in the protective packing. It isn't much fun to accidentally throw away parts that you will need to complete your project.

The first thing to do is read the instructions and see if they sound like they will be easy to follow. The Oak Hills instructions are some of the best I have ever come across. They have a section that gives good soldering tips and tips that will help make building the rig more fun.

The instructions call for you to check and ensure that all the parts have been included. I first check off all the parts and label them on a piece of paper and stick the wires of the components through the paper. This gives me a chance to make sure all the parts have been included, familiarizes me with the parts, and gives me a double-check about putting the correct parts in the right holes on the board. I check the parts once while I am going through the check-off list and then again before I place them on the board. This helps eliminate one of the two biggest errors in kit building: putting a part in the wrong place on the printed circuit board. While I am sorting parts that are small and hard to identify, I use a lighted magnifying glass (Radio Shack 63-848). I put about five parts on the circuit board at a time, then solder all the leads and clip the ends close to the board. For IC chips I usually place each socket on the board, one at a time.

"It was a real pleasure after a hard day of work to let my mind relax and just sit down and build."

I have some soldering suggestions as well. Use only good rosin core solder and use a soldering iron that has a nice thin pencil tip and is 25 or 30 watts. Oak Hills Research recommends 25 watts, but I use a 30-watt iron for all my building. Make sure the tip of the iron is pointed and clean. I have also found that having desoldering braid (Radio Shack 64-2090) is helpful if you put a part in the wrong place or accidentally solder things together (a solder bridge). When soldering plated-through boards, a desoldering tool (Radio Shack 64-2120) is very helpful. The key to soldering is how and where to hold the soldering iron. Hold the soldering iron at about a 45-degree angle and make sure you are heating both the hole and the wire from the component. Take the solder and have it in your opposite hand from the iron and on the opposite side of the hole from the soldering iron. Allow the heat from the iron to cause the solder to melt. Don't take the solder and let it flow off the iron as many people do. If you allow the solder to flow off the iron and not heat the whole soldering joint the component may not really be electrically connected to the place it is supposed to be, or it may be partially connected and break after some period of time. The two most common causes of kit failure are incorrect part placement and cold soldering joints.

Many good kits suffer from instructions that are not exactly easy to follow. I followed the instructions provided with this kit. I didn't find anything confusing or ambiguous. It was a real pleasure after a hard day of work to let my mind relax and just sit down and build. I took my time with this project because I knew that my work schedule was real tight, and it is much harder to find and fix a building error than to build it right in the first place.

Even though I took my time, I found that this project went quickly. I guess my only complaint with this kit was that it was such a pleasure to build that I missed having the project to look forward to after work once I completed it.

Aligning the Rig

The fateful moment had arrived. There were no more building instructions left, only testing and alignment. To align the rig you will need a voltmeter, a QRP dummy load, a QRP wattmeter, a frequency counter and preferably a commercial station rig. You may get by with less equipment, but I recommend doing the alignment almost exactly as explained in the instructions. If you are a new builder and don't feel comfortable with this procedure, or don't have the necessary equipment, you can send your rig to Oak Hills and they will align it for $30.

It is suggested that you apply power and let it warm up for 30 minutes before doing any alignment. Putting power on a newly completed rig is both exciting and anxiety provoking. Even if you are a careful builder, it is always possible that you left a tiny solder bridge or put two or more parts in the wrong place on the printed circuit board. I had a kit that I very carefully assembled. I got ready to power it up and put it on my work bench. I had checked the solder side of the board with a magnifying glass a number of times while building, and then again when I completed the kit. I didn't know it at the time, but some solder remains were on the bench and formed a solder bridge. When I applied power there was a sizzle and smoke. This time I carefully cleaned the bench, and made sure I had a clean piece of paper between the bench and the board. I used a bench power supply and turned the amps down way low on first power up to try to cut damages to a minimum in case of a problem.

The moment of truth was at hand. The wires were in place, the power supply was turned down, and it was time to turn on the rig. I turned the Audio Frequency (AF) control to power on the rig. The red power indicator on the front panel of the rig glowed a very pleasing red. I waited without breathing for a few seconds and didn't smell any smoke or hear anything that sounded like components exploding. I smiled a very self-satisfied smile.

The first part of the alignment involves connecting a frequency counter and adjusting a capacitor and coil to get the VFO on frequency and get it to provide 100 kHz coverage. With the 20 meter rig I did something slightly different. I was only interested in using from 14.000 to 14.070. I did the adjustments using this range instead of the 100 kHz range suggested. The advantage of this was that I was able to get the dial that indi-

cates frequency on the rig to be fairly exact. If I am to have a schedule with someone on 14.026, I am now confident that we will be on the same frequency. I found it very hard to try to do an accurate adjustment for the entire 100 kHz, but above 14.070 are the digital modes and I wasn't really concerned about the dial reading accurately in this range.

The next thing you do is adjust a variable resistor to the specified voltage using a voltmeter. This was a very easy and quick adjustment. Next, you hook up an antenna to the rig and adjust the sidetone note with a variable capacitor. Once again, this was quick and easy.

To get the receiver adjusted you adjust two coils for maximum signal strength by listening to the rig with headphones. These were broad adjustments on the kit I built and very easy to do.

When tuning the transmitter you should hook up a dummy load. There is a variable resistor to adjust the power output level and then one variable capacitor that you just turn until you observe maximum power output on a QRP wattmeter (or listen on a station rig that does not have an antenna connected to it.) You next adjust a trim capacitor while listening to your station rig until you hear a nice mellow tone of about 700 Hz. The final adjustment is a resistor for the sidetone level. The entire alignment did not take me very long. The only part that took some time was getting the VFO so that the dial reads the frequency fairly accurately.

On The Air

With a good kit I really enjoy the two parts involved: building the kit and then operating it. Well, the building went very well and I couldn't have asked for anything more to be done to make the building experience more pleasurable. It was time to see if it really worked. I took the rig over to my operating bench with the cover still off (in case I needed to make any last-minute adjustments). I tuned around the band and the receiver sounded great. It is very quiet and seems to be sensitive to weak signals, as well as able to do a good job at separating out signals.

I heard someone calling CQ. It was CT3FT. I gave him a call and he came back immediately. It was Cedric on Madeira Island. This was very exciting for me and a real good sign that the rig was functioning well. Next I had a nice long QSO with W6PTL, Mac in Porterville, California. He reported "signal is fine here." I sat there and easily made contact after contact. My rig puts out 3 watts when powered with 13.8 volts and 2 watts when powered with 12 volts. The QSK is solid-state and works great. I have really enjoyed operating this rig.

The Bottom Line

The bottom line is that I feel this kit is a real bargain at $129.95. And, it was fun both to build and to operate. You can easily make many contacts using this rig with a battery and a wire antenna.

6 Meters— The In-Between Band

Excitement for all license classes.

by Gordon West WB6NOA

No-code Technicians are discovering a "secret" band of frequencies that few people talk about these days during the sunspot cycle low: the 6 meter band from 50 to 54 MHz. This band is available to no-code Technician Class license operators, and higher grade licenses, with no restrictions on emissions, power output, or frequencies within the band. In other words, as a no-code Technician, you have the same privileges on 6 meters as an Extra Class operator would have!

The 6 meter band is divided into a band plan as adopted by the American Radio Relay League and recognized by the Federal Communications Commission. The band plan reserves certain frequencies for FM and repeaters, with the bottom portion of the band reserved for CW and SSB weak-signal operation. There are also plenty of frequencies reserved for packet communications.

Getting started on the 6 meter band using FM for simplex and repeater communications is a great way to meet "the gang." Once you get on the air on 6 meters, you will find special 6 meter clubs whose only interest is pioneering the 6 meter band. Go to a club meeting and get a list of all of the local 6 meter repeaters in your area, and see how far 6 meters propagates compared to what you're presently getting for 2 meter range direct and through repeaters.

Photo A. Bob K6PHE and Gracie KK6CG Hastings run handhelds in Southern California. They love the excitement of 6 meter FM!

Compared to 2 meters, 6 meter simplex gives you better range in the mountains and over hills. The longer wavelength is less attenuated by hills and trees, so you may find a remarkable increase in communications range on 6 meters versus what you have been enjoying on 2 meters.

Working through 6 meter repeaters is similar to 2 meters—50 to 75 miles is common.

But get set for the fireworks when the band opens up on 6 meters this summer. During the summer months, invisible ionized dense patches of "E-layer clouds" will drift from the West Coast to the East Coast, sometimes opening up your simplex and repeater communications to beyond 1,500 miles! One minute you're working through your local repeater in town, and a few seconds later during the summer months another repeater in another city a thousand miles away begins to override your local repeater, and a distant station acknowledges your call up to 1,500 miles away.

ARRL 6 Meter Wavelength Band Plan, 50.0-54.0 MHz

MHz	Use
50.100-50.300	SSB, CW
50.100-50.125	DX window
50.110	SSB calling frequency
50.300-50.600	Non-voice communications
50.620	Digital/packet calling frequency
50.800-50.980	Radio control
	20 kHz channels
51.000-51.100	Pacific DX window
51.120-51.480	Repeater inputs (19)
51.120-51.180	Digital repeater inputs
51.620-51.980	Repeater outputs (19)
51.620	Digital repeater outputs
52.000-52.480	Repeater inputs (23)
52.020, 52.040	FM simplex
52.500-52.980	Repeater outputs (23)
52.525, 52.540	FM simplex
53.000-54.480	Repeater inputs (19)
53.000, 53.020	FM simplex
53.1/53.2/53.3/53.4*	Radio control*
53.500-53.980	Repeater outputs (19)
53.5/53.6/53.7/53.8*	Radio control*
53.520	Simplex
53.900	Simplex

*Optional, local choice

From *Gordon West Amateur No-Code Plus Book*, Master Publishing, Inc.

Even though we are at the bottom of Solar Cycle 22, the summertime Sporadic-E 6 meter band openings will continue to occur independent of the solar cycle. And it's a guaranteed event—during May, June, July, and August, the 6 meter band "opens" for Sporadic-E FM and SSB communications over distances up to 1,500 miles. This summer, I predict the band will open up at least two or three days every week. In the morning hours, listen for stations coming in from the East. In the afternoon hours, listen for stations coming in from the West. The best time to talk "skip" is a few hours after local sunrise, mid-afternoon, and during an evening peak around 7:00 p.m. local in the direction of the west. During lunchtime, you can expect stations to come in this summer from Canada, as well as South America.

Your antenna considerations are simple—home-brew your own 54" ground plane with 54", 45-degree downward-sloping radials, and feed it with good coax, or consider one of the excellent collinear 6 meter base station antennas from Diamond or Comet. For mobile installations, an old state police 54" whip works nicely on 6 meters—or if you have the bottom half of a Hustler fold-over HF mast, you will find it works dandy as a quarter-wave whip on 6 meters.

If you have a base-loaded 2 meter mobile antenna, unscrew the loading coil and screw in a 6 meter coil with the appropriate yard-long whip. 73

73 Review

Number 9 on your Feedback card

by Gordon West WB6NOA

Alinco Electronics Inc.
438 Amapola Ave.. #130
Torrance CA 90501
Telephone: (310) 618-8616
Fax (310) 618-8758
Price Class: $459

The Alinco DR-MO6

A new 6 meter mobile transceiver.

Alinco Electronics has just introduced their new 6 meter mobile transceiver DR-MO6 with built-in CTCSS tone encode, and an incredible 100-memory channel capacity straight out of the box to memorize your local and all-country 6 meter repeater and simplex channels. Use the ARRL repeater directory for memorizing 6 meter repeater frequencies, and don't be surprised to see different offset frequencies for different parts of the country. Most of the country uses a -1.6 MHz split, but the Columbia Region 6 Meter Association, representing Washington, Oregon, and British Columbia, uses an input/output spacing of 1.7 MHz, giving them 60 repeater pairs and up to 25 simplex channels. The 6 meter national FM 6 meter simplex frequencies are 52.525 and 52.540, and California operates FM simplex at 50.3 MHz.

The tiny Alinco does it all with 10 watts of FM power output. We actually measured 12 watts of power output when our vehicle was running and the input voltage was 13.8 VDC. The Alinco transceiver also ran extremely cool because of all the fins on the heat sinks, and we were surprised to see a transceiver this small keep its temperature down during long periods of transmit.

The Alinco DR-MO6 also uses a dual-conversion receiver, and here in L.A. it's really necessary to keep out image frequencies and other nearby signals. We measured receiver sensitivity at 0.1 microvolts at 12 dB SINAD—16 dBu. Power output was judged "very loud" at 3 watts from the top-mounted speaker. A typical speaker jack allows you to remote-mount a speaker in extremely noisy vehicles.

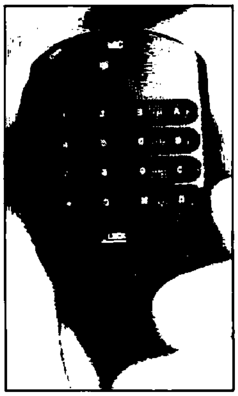


Photo C. The full-featured Alinco 6m mobile microphone.

The Alinco mike incorporates up-and-down keys to zing through the channels, or to review memorized channels. If you hold down the button, it launches the radio into scanning. There is a lock key on the front of the mike that you can engage with your thumb to cancel the effects of pushing the up or down button. Very handy—select the frequency of choice off of the mike, click on the lock button, and you won't need to worry about accidentally jumping off frequency.

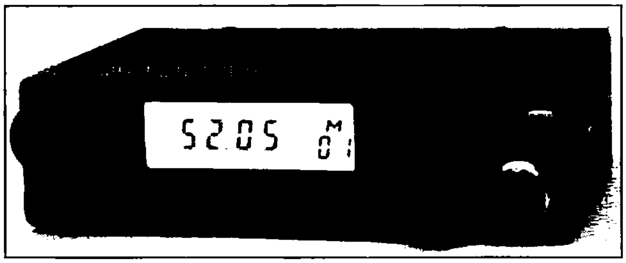


Photo A. The Alinco DR-MO6.

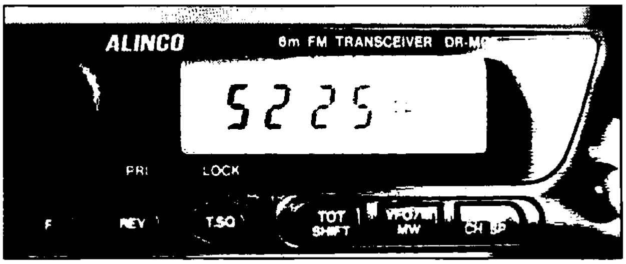


Photo B. The new Alinco 6 meter radio was easy to operate with its logical layout of buttons and sub-functions.

Operation

The operation of the transceiver is straightforward—you don't even need to plow through the instruction manual. The function-shift allows you to program 1.6 or 1.7 MHz duplex operation, or for that matter, any split on any one of the 100 channels. The reverse button lets you listen in on the repeater input frequency to determine proximity to another station on the input. We liked the speed of the microprocessor when turning the big frequency knob to zip through the channels. We have tried other 6 meter FM sets and found that the microprocessor unlocks during a rapid spinning of the channel knob. This means you can zip through active frequencies without discovering they are actually in use. With the Alinco, a moderate tuning of the big knob allows you to quickly hear what's happening on many different frequencies without the synthesizer going out of lock. This is a good feature for those of us that like to spin the knob looking for activity! But with any microprocessor-controlled radio, spinning the knob too fast may cause you to overlook weak signals on the band.

We judged the Alinco squelch as typical of most other transceiver squelch circuits—hard squelch. Weak stations will chatter the squelch. and there is not enough hysteresis in the squelch to keep it open for a weak signal coming in and out of reception to stay on the air with the squelch circuit open. I opened up an old Commtronix 6 meter radio that has been sitting around my shack for the past 15 years. and discovered a simple improvement to make to the squelch circuit on my present Alinco by adding several tantalum capacitors to keep the squelch open during weak-signal reception. The only disadvantage after my modification was a rather long squelch tail after a strong signal disappeared on receive. But for weak signal reception, the long squelch tail kept the squelch from chattering closed.

The LCD readout was a big improvement over my old Commtronix FM rig that used dull, hard-to-see LEDs. At nighttime, the Alinco LCD panel had plenty of brightness from the backlights.

But best of all with the new Alinco is its 100 channels of memory. While you wouldn't *think* that you need 100 channels on 6 meters, you really should stuff in at least 40 to 50 repeaters, in and out of your area, to get set for when the band opens. With the built-in CTCSS, reading over the ARRL repeater directory will give you a good idea of what tones to put into what channels, and what channels to scan for activity when the band opens up this summer.

The bright display and easy to use features make the new Alinco an inexpensive way to get on the fabulous 6 meter bands, where skywave DX to the no-code operator may be an every-week occurrence this summer—from 50 MHz to 54 MHz, the 6 meter band is full of surprises. 73

Number 10 on your Feedback card

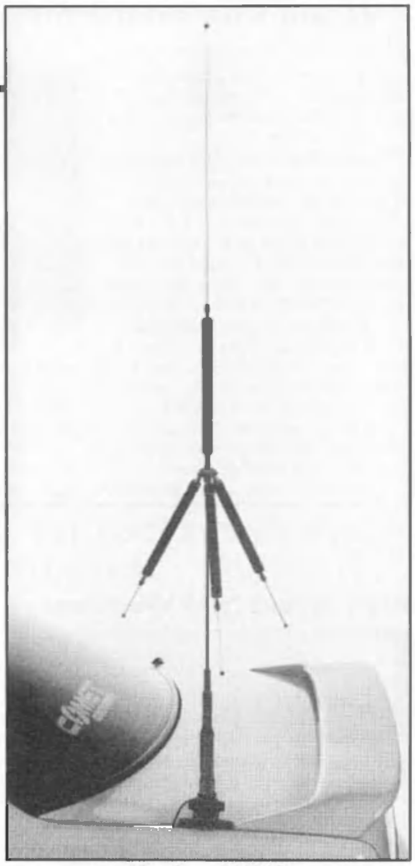
73 Review

by Barry Kennedy N2PNG

The Comet HA4S

A mobile HF antenna.

NCG/Comet
NCG Companies
1275 North Grove Street
Anaheim CA 92806
Telephone: (714) 630-4541
Fax (714) 630-7024
Price Class: $199
Optional 20 meter coil—$39



The Comet HA4S.

Ever since the introduction of several small HF transceivers there has been a huge influx in the amount of HF mobiling. It is now very easy for anyone to throw a rig in the car and operate on those long road trips. Choosing the right antenna can be the hardest part of the whole installation. With so many different makes and models available, deciding what is best suited for your needs can be confusing and difficult.

With so many of us driving small cars today and living in urban areas, the size of the antenna can be a problem. Several months ago I noticed the Comet HA4S pictured on the cover of *73* magazine. What a neat-looking antenna—small, and having the ability to fold over like some of the fancier VHF/UHF antennas. Finally, it's a small antenna that you don't have to take off the car to pull into the garage.

It is important to understand that any mobile antenna is a compromise. There is no mobile antenna that is as efficient as a yagi or a quarter-wave vertical with elevated radials. I have found that generally the bigger antennas tend to be more efficient and have a greater bandwidth. You gain a small size with many HF mobile antennas, but you tend to lose bandwidth and efficiency. I was curious to see how well the Comet HA4S performed compared to some of the larger antennas that I have used.

The Comet HA4S

The HA4S is considerably smaller than most HF mobile antennas, measuring only 4'4" tall and weighing just over a pound. It is rated to handle 120 watts SSB. The HA4S comes standard with four bands: 40, 15, 12, and 10 meters. Each band is a separate coil that attaches to a mast, similar to the Hustler antennas. An optional coil can replace one of the existing ones, adding the 20 meter band. The 40 meter coil screws into the top of the mast while the other three coils screw into a circular hub just below the 40 meter coil. The coils slope downward, making the antenna appear somewhat like a discone. Comet thoughtfully includes a wrench for proper tightening of the coils to the mast. The assembly of the antenna was extremely easy and straightforward—it took all of about three minutes to complete.

The connector on the end of the mast is a standard UHF male (PL259). Most antennas use the heavier duty 3/8" threaded mount. The reason for this is that the bigger the antenna is, the greater the windload is going to be, and the 3/8" is just a stronger mount capable of handling much larger loads. After flipping through my catalogs I found that several manufacturers make heavy-duty mag-mounts as well as rail and lip mounts, with the UHF female, that are more than capable of handling the HA4S.

The mast on the HA4S folds over just like some of the fancier VHF/UHF antennas. This is a great feature: no more taking the antenna on and off each time you pull into the garage. To lower the antenna, unscrew the collar surrounding the fold-over hinge, lift the mast out of the socket, and it will fold over to the side. To right the HA4S, pull the antenna vertical and back into the socket and tighten the collar, locking it back into place.

Tuning the HA4S

As I mentioned, the use of coils and traps limits the bandwidth of an antenna somewhat, and is not as efficient as using a full-size antenna. Comet claims that the antenna will resonate in any 46 kHz section of the 40m band with a 2.0:1 SWR or better. Bandwidth for each frequency range increases up to 660 kHz with a 2.0:1 SWR or better in the 10m range. To adjust the antenna to resonate in the desired segment of the band, you lengthen or shorten the whips on the coils. By making the whip slightly longer you lower the center frequency. Let's say I want my HA4S to resonate between 14.180 MHz and 14.220 MHz. I would first go to my center frequency, check my SWR, and adjust my whip accordingly until minimal SWR is obtained. This can be done by transmitting low power into the antenna and checking the measurements on your meter. I use an MFJ-259 SWR analyzer, an invaluable tool for tuning antennas or any other type of antenna work. It doubles as a frequency counter and an SWR bridge, allowing me to check the exact SWR of any frequency I specify. This tells me where my antenna is resonant and allows me to do this without the use of my transceiver. It is very important that you make sure you have good ground connection from your antenna to your car. A bad ground is often the cause of many problems, such as a high SWR.

I had no problem adjusting the coil for 10, 12, 15, and 20 meters. I picked my center frequency and adjusted the whip for the minimal SWR, then checked 20 kHz either side and found the SWR to be fine.

On 40 meters I had to trim the whip slightly before I was able to resonate the antenna above the CW portion of the band.

Performance

Most of my tests were conducted on 20 meter SSB, due mostly to propagation. Overall, I was impressed. The HA4S performed like a champ. On my drive back to college I was hearing strong signals from both W6 and W4 land. I worked EA3OT without any difficulty, and received a 57 report. Soon after, I was chatting with some guy in northern Florida with a 59 signal. I also made contacts on the other bands as well as 40 meter CW.

It is important to remember that this antenna was more than likely designed for the Japanese amateur, with small size and versatility in mind. In getting the nice small package, you lose bandwidth, making the HA4S fairly frequency selective once you have set your center frequency. If you try to operate outside the 20 kHz on either side of the center frequency you will notice a rapid increase in your SWR. However, if bandwidth is not your biggest concern and getting a small, excellent mobile antenna that has some unique features is, then the HA4S will do the trick. 73

A Foolproof Power Controller

Be prepared when the commercial power shuts off.

by Charles M. Seay, Sr. KN4HL

What happens to your community repeater when a storm or accident causes a loss of commercial power? The answer is that your repeater is useless unless you have a battery backup supply or a generator. Generators are expensive and have to be manually started unless they have a battery starter. Deep-cycle marine batteries are great for repeaters that draw 10 amps of current or less. The problem arises when the commercial mains go dead. The control operator or owner must manually switch power sources, as most repeaters are not located where the owner or control operator lives.

I found the answer to this problem with the "Foolproof Power Controller." This project consists of a relay which is engaged when the commercial mains are supplying power to the repeater and automatically switches over to my deep-cycle marine battery when commercial power stops. I have incorporated a two-color LED into the schematic to indicate visually from which power source the repeater is being supplied power. The parts list for this project is as simple as possible, with all the parts available from your local Radio Shack: a small aluminum case, four resistors, one two-color LED, a DPDT relay, one relay socket, one roll of red 18 ga. hookup wire and one roll of black 18 ga. hookup wire.

The most important thing in the construction of this project is to maintain the correct polarity so as not to damage any transistors in the repeater. Fuses can be added to the unit for additional protection if you wish.

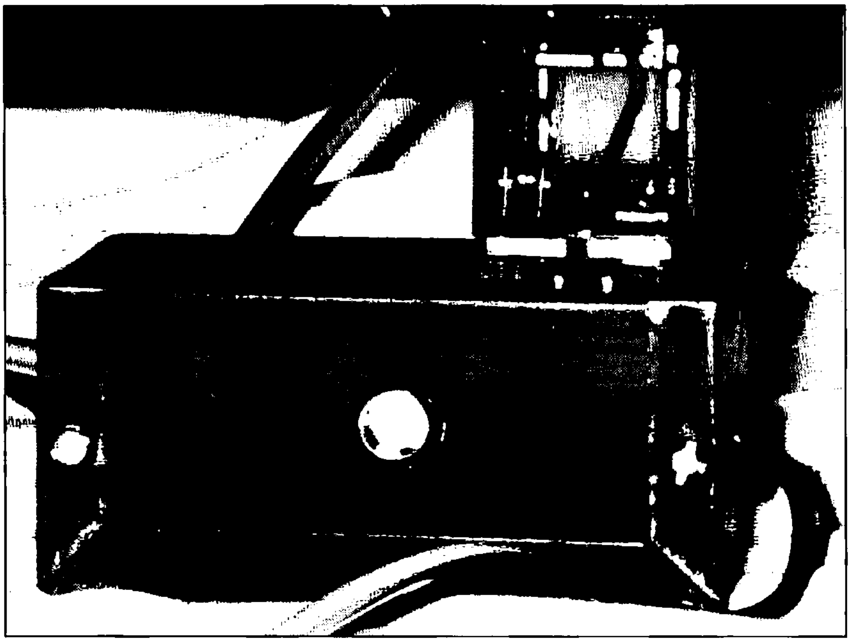


Photo A. The completed controller showing relay, case and LED.

Construction

The relay socket is mounted in the aluminum case so that the relay receives proper cooling and the exposed wiring will be totally enclosed in the case. The LED can be mounted where it can be easily seen; location is not important.

After the relay base is mounted, cut a length of red hookup wire that will reach from the positive terminal of your 13.8-volt power supply to pin 8 of the relay base with a jumper from pin 8 to pin 4 of the relay base. Cut an equal length of black hookup wire that will reach the negative terminal of your power supply and connect this to pins 7 and 3 on the relay socket. Now cut a piece of red hookup wire that will reach from the positive terminal on the battery and connect the other end to pin 2 on the relay socket. Cut a piece of black hookup wire that will reach from the negative terminal on the battery to pin 1 on the relay socket. Two equal black and red pieces of hookup wire should be cut that will reach from the relay socket to the power supply terminals on the repeater. Connect one end of the red hookup wire to pin 6 of the relay socket. Connect one end of the black hookup wire to pin 5 on the relay socket. The basic wiring of the relay socket is now complete and the unit will

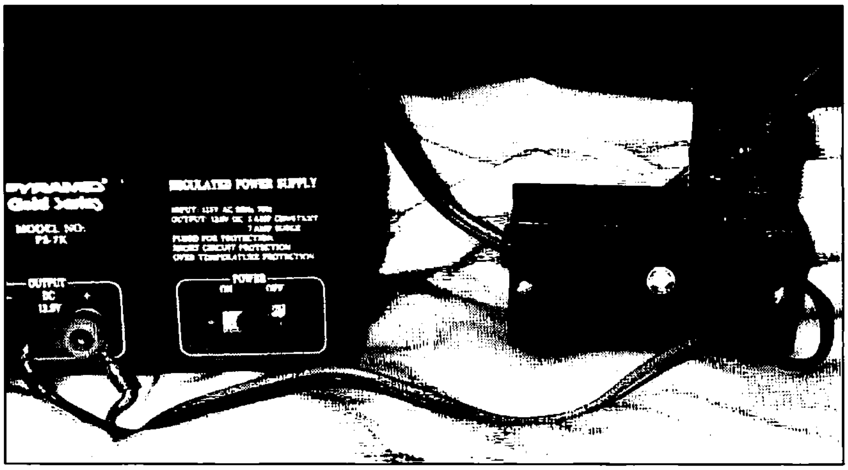


Photo B. The "Foolproof Power Controller" connected to the 13.8-volt DC power supply.

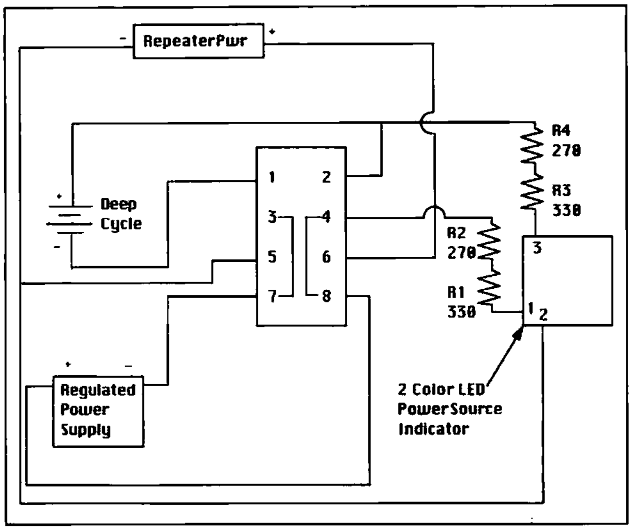


Figure 1. Schematic for the "Foolproof Power Controller."

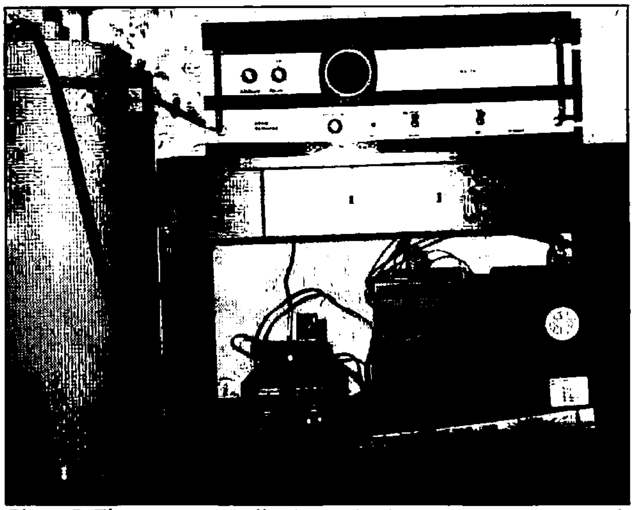


Photo C. The power controller in service in a repeater system, ready when commercial power fails, to switch instantly to the emergency battery supply.

operate correctly. However, you would not have any indication which power source is operating the repeater.

Mount the two-color LED into the cabinet of the case where it can be seen easily. Connect the center or long post of the LED to pin 5 of the relay socket. Connect pin 1, the shortest post of the LED, to pin 4 of the relay socket through two resistors (270- and 330-ohm resistors in series). Connect pin 3, the next shortest post on the LED, to pin 2 on the relay socket through two resistors (270- and 330-ohm in series). When in operation the LED will display green when operating from your regular 13.8-volt power supply and orange when operating from the deep-cycle battery. When commercial power is lost, the relay will switch to the battery automatically.

Before hooking this unit to a repeater, connect this controller to the proper post of the power supply and to the battery. Connect a multitester to the black and red hookup wires that go to the repeater, carefully observing polarity with the meter set to read at least 30 volts. The LED should be glowing orange without the power supply turned on. Turn on the power supply and the LED should glow green. If you unplug the power supply, the LED should again return to orange and voltage should still be present to the multitester.

Stick-on rubber feet can be added to the case after construction to keep the unit from sliding around.

This unit has worked for me for several months during short commercial power outages. It will keep your repeater operating and useable.

This unit can be adapted to control the power source of radios other than repeaters. The main limiting factor is the current-carrying capacity of the relay contacts and the size of the hookup wire.

The total cost to construct this project is less than $25. ■

Parts List

Quantity	Item	RS#
1	Case 2-3/4" x 2-1/8" x 1-5/8"	270-235
1	Relay	275-218
1	Relay socket	275-220
1	Dual-color LED in panel holder	276-025
2	270-ohm resistors	271-1112
2	330-ohm resistors	271-1113
1 roll	Black 18 ga. stranded hookup wire	

K4SYU Loop Antenna

A compact, portable HF solution.

by Everett James K4SYU

Why a small *loop?* Why not a dipole or a quarter-wave vertical? The answer is size and versatility. The loop is small and inconspicuous. It can be set up on the porch of a condominium or used as a portable antenna for Field Day or used as an emergency antenna in case the wire antennas blow down.

The loop will not replace your favorite yagi or other gain antenna, but if you are restricted, as many hams are, to using inside antennas and are getting poor results, then this loop is just what you are looking for.

Let's look at what this small loop antenna has to offer:

1. It requires no radials (no external wires).
2. It requires no ground connection (reduced RFI).
3. It requires no antenna tuner (simplified tune-up).
4. It exhibits less noise than a dipole or quarter-wave antenna.
5. It is somewhat directional (also has good nulls).
6. It helps eliminate harmonic radiation (high Q).
7. It is multiband (quick and easy band change, five bands).
8. It is fairly efficient (good things do come small).
9. It is portable (can fit in the trunk of a car).
10. It is inexpensive and easy to build. (Need I say more?)

Are you interested? Then read on.

Theory

You all know that the loop antenna has been used for many years as a direction-finding antenna. In that type of service it made use of the sharp nulls off each side of the loop, but off each end is a nice fat lobe shaped like a doughnut. It is this large lobe structure that makes the loop so interesting to radio amateurs.

In theory, the loop antenna can be looked at as a single-turn parallel-tuned circuit not unlike the tank circuit. The opposite sides of the loop act as a pair of spaced antennas carrying RF currents of opposite polarity. The two RF currents tend to cancel each other out perpendicular to the plane of the loop. The magnetic radiation will be maximum off each end of the loop. As the loop readily accepts energy at its resonant frequency, it is only necessary to add an RF coupling device to transfer energy to and from the loop via a coaxial cable.

You know that the portion of the loop next to the capacitor has very high voltage, but if we go to a point halfway around the loop which is about the center of a corresponding one-turn coil, we reach a zero voltage point. This point, for all practical purposes, is neutral. It is at this point that the coaxial shield is attached. The coaxial center conductor is connected to a number 12 wire which is separated slightly from the loop and connected at a point approximately 10 percent of the loop circumference away from the neutral point. This is very similar to the old-time method of using a tapped coil for impedance matching.

It is interesting that a reasonable match can be obtained on all five frequency bands using this simple matching device, without having to move the tap.

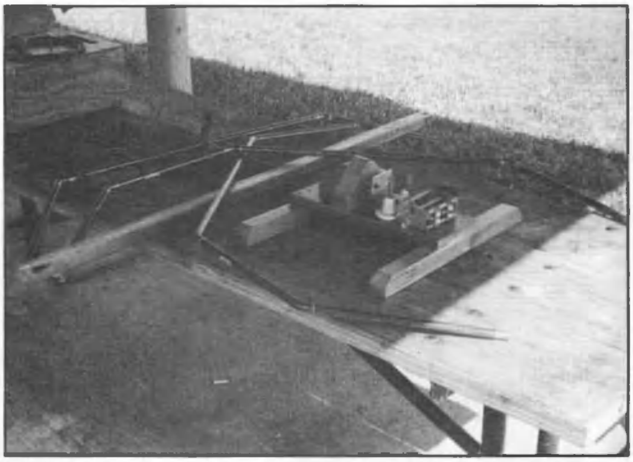


Photo A. The loop antenna in pieces before assembly. Assembly time is about five minutes.

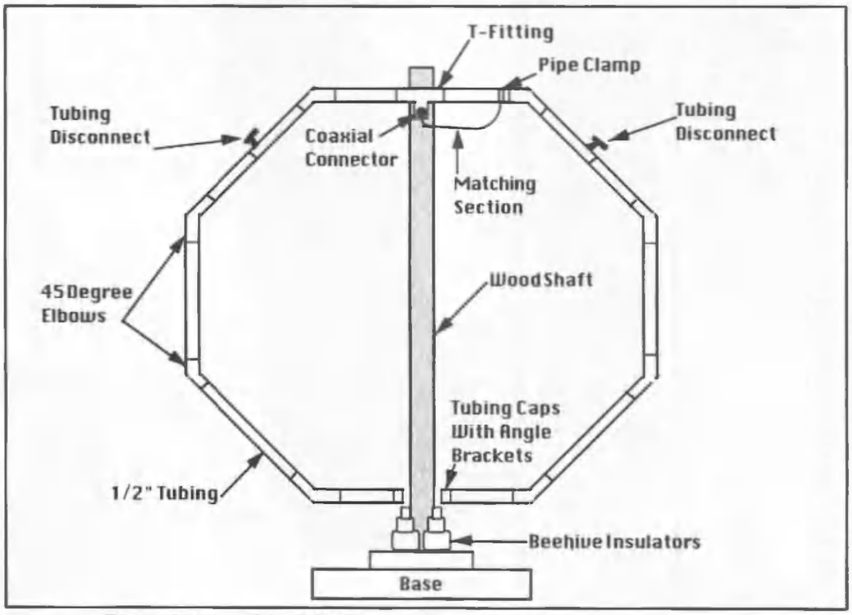


Figure 1. View of the K4SYU loop without the tuning capacitor mounted.

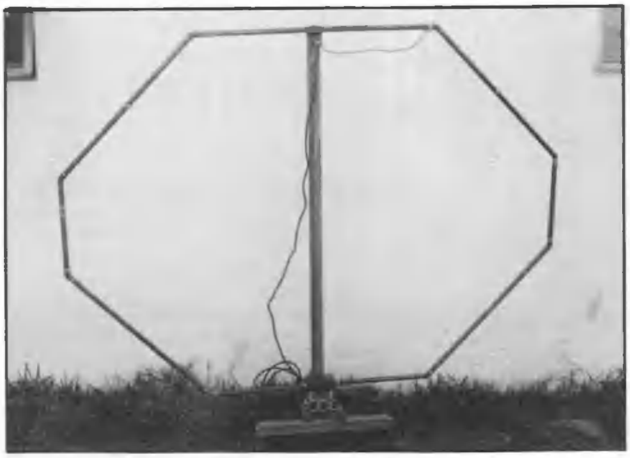


Photo B. The loop antenna, showing the matching section and coaxial cable feed point at the top.

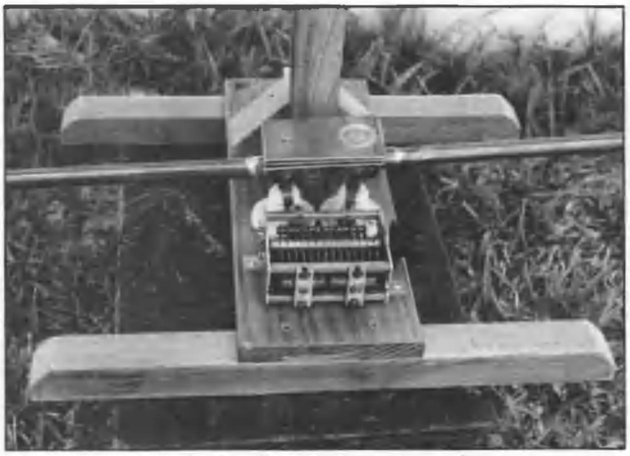


Photo C. Details of the loop antenna base.

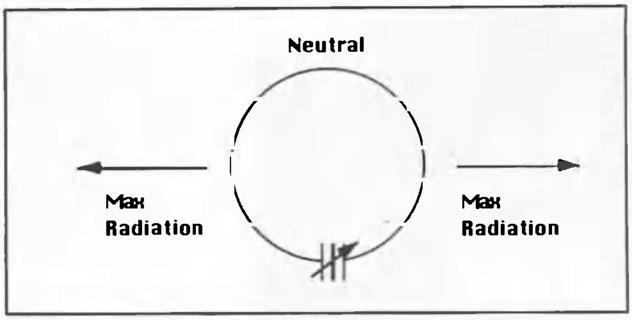


Figure 2. The loop's radiation pattern.

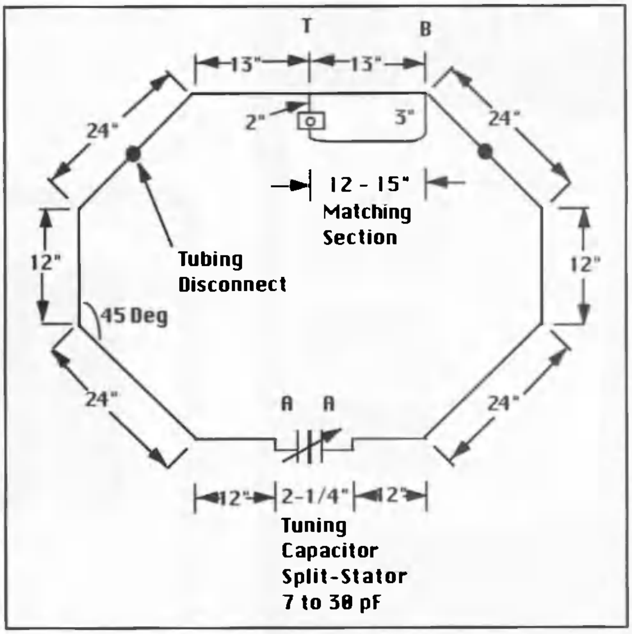


Figure 3. Plan of the K4SYU loop.

Bands

This loop covers the 15, 17, 20, 30, and 40 meter bands. That is not bad for an antenna which can be set up on a table top and take up not much more space than five feet.

Can a Loop Antenna This Small Be Efficient?

The answer is yes. This antenna was designed with the idea of operating it QRP. The calculated maximum gain for this loop on 20 meters is approximately 3.2 dB above isotropic. It also has nulls of approximately 12 dB off each side. Calculated losses below 100% efficiency are 0.13 dB for 21 MHz, 0.4 dB for 14 MHz, and 3.2 dB for 7 MHz.

The good news is that this loop will not cost you a bundle. The construction of this loop is simple enough that any radio amateur with ordinary mechanical skill and simple tools can build it. How about cost? I would estimate that the cost would be less than 35 dollars. Not bad for a five-band antenna! It could be even less if you have a good junk box. The half-inch hard drawn copper tubing and fittings cost me $11 at the local plumbing supply shop. The variable capacitor and beehive ceramic insulators were obtained at a hamfest for a few dollars. and the wooden stand was made out of scrap lumber. You can make yours real fancy if you desire.

You say you want a loop antenna but you do not want to be confined to QRP? Look no further: this small loop will handle power outputs up to 100 watts peak. The tuning capacitor that I am using is a medium-power transmitting type with 0.075-inch spacing between plates. The two stators are in series through the rotor, which gives a plate spacing of 0.15 inches but cuts the effective capacity in half. This spacing will handle more than 10k volts of RF.

Using a split-stator capacitor with each stator connected to one end of the loop, the RF voltage on the rotor and frame is near zero and the frame can be attached directly to the wooden base. The capacitor can be tuned using a good bakelite knob as shown in Photo D. Of course, if you want, you may add a motor drive. I do not recommend using a non-split-stator capacitor as the rotor will be at a high RF potential and there is a danger of RF burn. The inductance of this loop is approximately 5 μH. If you have a capacitor and you know its value, just use the formula

$$F = \frac{10^6}{2\pi\sqrt{LC}}$$

to find your frequency coverage at maximum and minimum capacity.

Tune-Up

The tune-up is very easy. First, select the band on which you wish to operate, then resonate the loop. When the loop is near resonance the received noise level and signals will peak.

You could operate with this tune-up but you probably would not get maximum power transfer. I recommend that you use a VSWR meter in the transmission line. Set the VSWR meter for reflected power, reduce the drive level at the transceiver until reflected power is mid-scale or less, then adjust the loop tuning capacitor for minimum return power. Increase power and re-adjust again for minimum. You should now have maximum power transfer for that segment of the band as allowed by your loop bandpass. Tune-up should not take much more than a minute if your rig is located near the loop antenna.

High Q and Bandpass

The high Q of the loop will work both for and against us. It will help reduce the received noise and it will attenuate harmonic

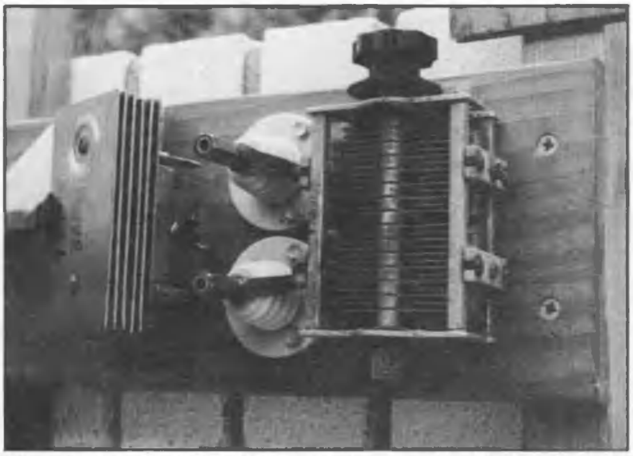


Photo D. Details of the split-stator tuning capacitor, the beehive insulators, and the plug-in 40 meter capacitor.

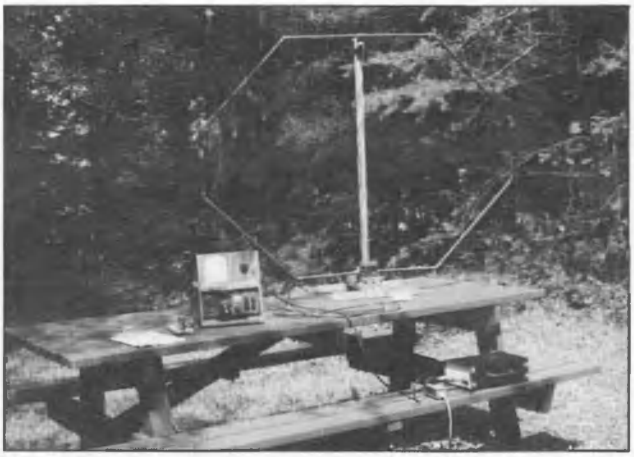


Photo E. The loop and rig set up on a picnic table in a North Georgia park.

radiation. It will not allow us to move up and down the band without re-resonating the loop to the new operating frequency.

The following bandpass figures were measured using this loop:

Band	Bandpass
15 meters	138 kHz
17 meters	Not measured
20 meters	57 kHz
30 meters	23 kHz
40 meters	15 kHz

These bandpass figures indicate the limits between 2.5:1 VSWR points for each band. It is easy to see that as the frequency decreases the bandpass becomes smaller, the tuning of the loop becomes more critical and the efficiency also decreases.

I haven't encountered any problems thus far in manually tuning this loop, as the loop is operated next to the transceiver. If the loop is to be operated at a location at a distance from the rig, then a motor drive mechanical tuner will be required.

Construction

As you can see in Figure 3, the loop antenna is octagon-shaped, but is a little shorter than it is wide. This was done in order to provide clearance from the ceiling when operated from a tabletop.

About 16 linear feet of half-inch hard-drawn copper tubing is required. Using a tubing cutter or hacksaw, cut the tubing to the lengths shown in Figure 3. Clean the portions of the tubing to be soldered, using emery cloth. Also clean the interior of all fittings. Make two copper angle brackets and attach them to the two copper pipe caps with self-tapping screws. Clean the caps and brackets for soldering.

Lay the parts out flat on a concrete floor. Use acid soldering flux on all joints and assemble the loop. Use wooden blocks to raise the loop above the level of the floor, keeping it flat for soldering. Use a propane torch and heat the fittings one at a time. Use lead-tin solder, the same as is used in radio work. The solder will be drawn into each joint when hot enough. You may wipe excess solder off using a damp cloth if you wish.

Note the position of the copper T-fitting (Figures 4 and 5) at the top of the loop. It is used as the upper support, as it fits into a hole in the vertical support shaft.

When all of the tubing joints are soldered the loop should look like the plan drawing in Figure 3. The loop will be rigid and have no loose joints. Make a vertical wooden shaft 1-1/2" x 1-1/2" x 52" long.

Make a 14" x 18" wooden base as shown in Photo A. Make a wooden support for the vertical shaft to hold it at right angles to the base.

A copper bracket is required for the SO-239 coax fitting. It may be screwed or soldered to the copper T-fitting as desired. Mount the beehive insulators on the wooden base along with the split stator capacitor. Fasten parts down with wood or sheet metal screws using brackets as needed on the capacitor frame.

Make connectors out of copper strip to go between the insulator tops and the capacitor stators. Try to have these connectors as short as possible.

The loop as presently set up will cover the 15, 17, and 20 meter bands. In order to resonate it on the 30 and 40 meter bands, additional capacitance must be added in parallel with the existing split-stator variable capacitor. This is done by attaching two banana jacks to the top of the beehive insulators. Fixed plug-in capacitors can then be added in order to work the 30 and 40 meter bands.

Construction of the Fixed Capacitors

The fixed capacitors are made of double-sided copper printed circuit board using air as a dielectric. The printed circuit board is cut into plates which are stacked in such a way as to make a high-voltage capacitor.

Figure 6 shows the size and shape of the fixed capacitor plates. Three plates are used for the 30 meter capacitor; six for the 40 meter capacitor. The approximate capacity of the 30 meter capacitor is 30 pF; 75 pF for 40 meters.

All plates are cut with a large pair of tin snips.

The plates are then stacked and holes drilled to accept two 6-32 screws. Remove the copper from around the hole on one end of each plate. As we are using double-sided printed circuit board, the copper must be

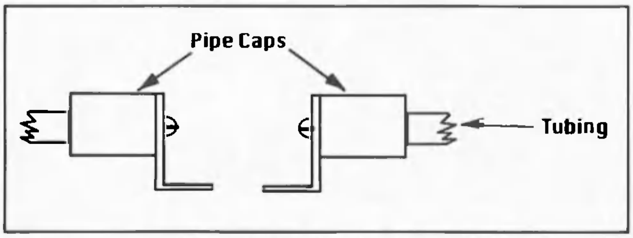


Figure 4. Base bracket detail.

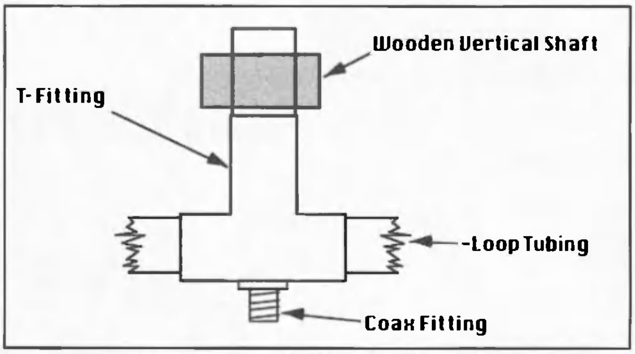


Figure 5. Copper T-fitting detail, top view.

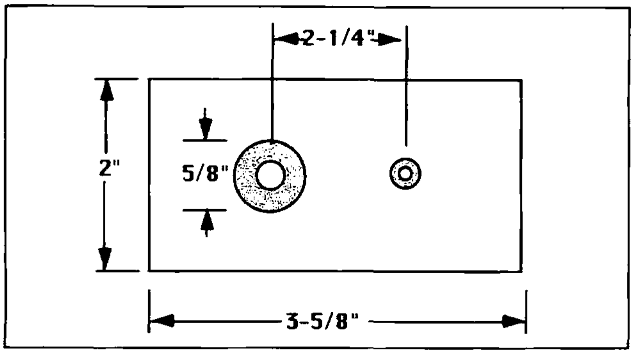


Figure 6. Detail of fixed capacitor plates.

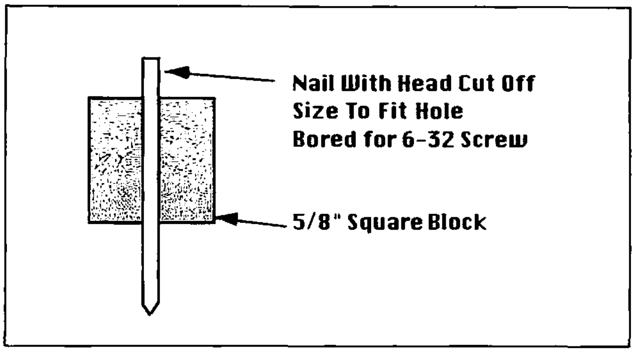


Figure 7. Detail of grinding tool.

removed from around the same hole on both sides. This can be done quickly by grinding the copper away using a homemade tool in an electrical drill or drill press (Figure 7).

Fasten a small strip of emery cloth to the grinding tool, passing the nail through the emery cloth. Insert nail in one side of the printed circuit board in the drilled hole, and rotate the tool using an electric drill. The copper will be removed quite rapidly.

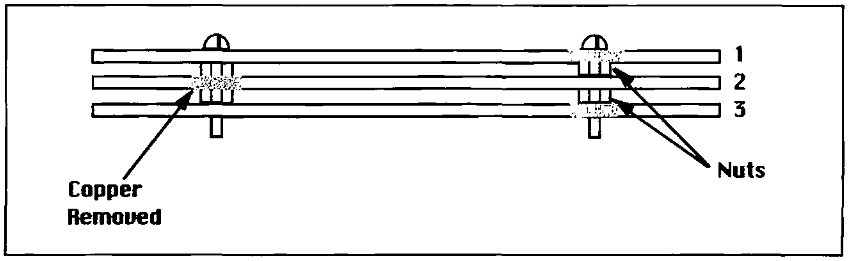


Figure 8. Stacking the capacitor plates.

Stacking the Capacitor Plates

Referring to Figure 8, you can see that on the left-hand terminal plates 1 and 3 are connected while the right-hand terminal is connected only to plate 2. A common 6-32 nut is placed on the screw between each plate and on top of the stack of plates. This gives a spacing of about 0.1 inch.

Loop Antenna Tubing Disconnects

For those radio amateurs who intend to use the loop as a portable antenna or frequently move it from one place to another, it can be equipped with tubing disconnects. The loop will then break down into three sections of no more than four feet in overall length, which will allow it to be easily carried in the trunk of a car. The tubing is cut at the two tubing disconnect points. A brass insert is made with a good fit to the interior of the tubing. It is soldered into one section and, with the loop assembled, a hole is drilled through the mating tubing section. The brass insert is then tapped for a screw thread. A 6-32 or 8-32 screw, as available, can be used to secure the sections of the loop together and make a good mechanical and electrical connection.

A word of caution: This loop concentrates very high levels of magnetic radiation and should be kept away from people and metal objects, both of which will absorb energy. This could cause a hazard.

Conclusion

For the past six months, I've used this loop antenna every Tuesday in a mini-Field-Day operation to make contact on schedule with W2GUM in New Jersey on 20 meter CW. Signal reports have frequently been S9, even with poor band conditions. Some of the contacts were made using QRP. The setup as shown in Photo E is portable from a park in North Georgia. My rig is a Ten-Tec Argosy. Its output is either 5 or 50 watts, depending upon whether I want to operate QRP. The antenna has helped make many contacts on 15, 20, 30, and 40 meters. Most of the operation has been portable battery-powered from a city park in Melbourne, Florida. The loop has also performed very well on DX contacts.

We have a small QRP club, and two other members, W4MPT and N4MPD, have built loops from these plans. Both are very happy with the results.

My recommendation is, try it, you will like it.

For more information see the Ted Hart W5QJR article in the June 1986 issue of *QST*. I would like to thank Burt Bittner KØWQN for his suggestions and computer tab-outs modeling this antenna. For loop theory, see *Electronic and Radio Engineering* by Terman.

Parts List

8	Copper elbows 1/2" dia.
1	Copper T-fitting 1/2" dia.
2	Copper end caps 1/2" dia.
14-1/2'	Hard-drawn copper tubing, 1/2" dia.
1	Coaxial connector, female type SO-239
2	Beehive insulators
1	About 2' of No. 12 solid copper wire
1	2" x 4" copper flashing
1	Tuning capacitor, split-stator type*
1	Wooden base, 1" x 6" x 14"
2	Wooden legs, 1-1/2" x 1-1/2" x 18"
1	Wooden vertical shaft, 1" x 1-1/2" x 51"
1	Double-sided circuit board, 3-5/8" x 18"**
1	Banana jacks**
4	Banana plugs with 6-32 threaded ends**
4	Brass screws, 6-32, 1" long**
18	Nuts 6-32 to fasten plates**
1	Hose clamp, small, stainless steel

* Note: The split-stator capacitor which I used was made by Cardwell, and was removed from a plug-in unit from a surplus SCR 188 MOPA transmitter. The capacitor was not split-stator and it measured about 30 to 130 pF. The stator was supported by four insulators attached to the frame. I drilled and filed through the center of the bars holding the stator plates. I removed the center stator plate and made two separate stator sections with 3/16-inch spacing between the stator bar sections.

** Note: If you have trouble finding the banana plugs and the double-sided printed circuit board, a transmitting type variable capacitor may be substituted and may be connected to the loop using battery clips. The variable capacitor should have a maximum capacity of about 100 pF. It does not need to be a split-stator type.

If this substitution is made, then all ** items may be omitted.

Number 13 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Noise, Signals and Amplifiers

Although gain, bandwidth and the shape of the passband are important amplifier characteristics, we must also concern ourselves about circuit *noise.* In the spectrum below VHF, man-made and natural atmospheric noise sources are so dominant that receiver noise contribution is trivial. But at VHF and above, receiver and amplifier noise sets the performance of the system.

At any temperature above Absolute Zero (0° K or -273° C) electrons in any material are in constant random motion. Because of the inherent randomness of that motion, however, there is no detectable current in any direction. In other words, electron drift in any single direction is cancelled over short time by equal drift in the opposite direction. There is, however, a continuous series of random current pulses generated in the material, and those pulses are seen by the outside world as a noise signal. This signal is called by several names: *thermal agitation noise, thermal noise* or *Johnson noise.*

It is important to understand what we mean by "noise" in this context. In a communications system the designer may regard all unwanted signals as "noise," including man-made electrical spark signals and adjacent channel communications signals, as well as Johnson noise. In other cases, the harmonic content generated in a linear signal by a non-linear network could be regarded as "noise." But in the context of amplifiers and receivers, "noise" usually refers to thermal agitation noise.

Amplifiers and other linear networks are frequently evaluated using the same methods, even though the two classes appear radically different. In the generic sense, a passive network is merely an amplifier with negative gain or a complex transfer function. We will consider only amplifiers here, but keep in mind that the material herein also applies to other forms of circuits as well.

Amplifiers and receivers are evaluated on the basis of *signal-to-noise ratio* (S/N or "SNR"). The goal of the designer is to enhance the SNR as much as possible. Ultimately, the minimum signal detectable at the output of an amplifier is that which appears above the noise level. Therefore, the lower the system noise, the smaller the *minimum detectable signal* (MDS).

Noise resulting from thermal agitation of electrons is measured in terms of *noise power* (P_n), and carries the units of power (watts or its sub-units). Noise power is found from:

$$P_n = KTB \qquad \text{(Equation 1)}$$

Where:
P_n is the noise power in watts (W).
K is Boltzmann's constant
(1.38 x 10^{-23} J/°K).
B is the bandwidth in hertz (Hz).

Notice in Equation 1 that there is no center frequency term, only a bandwidth. True thermal noise is *gaussian,* or near-gaussian, in nature, so frequency content, phase and amplitudes are equally distributed across the entire spectrum. Thus, in bandwidth limited systems, such as a practical amplifier or network, the total noise power is related only to temperature and bandwidth. We can conclude that a 20 MHz bandwidth centered on 200 MHz produces the same thermal noise level as a 20 MHz bandwidth centered on 400 MHz or some other frequency.

Noise sources can be categorized as either internal or external. The internal noise sources are due to thermal currents in the semiconductor material resistances. It is the noise component contributed by the amplifier under consideration. If noise, or S/N ratio, is measured at both input and output of an amplifier, the output noise is greater. The internal noise of the device is the difference between output noise level and input noise level.

External noise is the noise produced by the signal source, so is sometimes called *source noise.* This noise signal is due to thermal agitation currents in the signal source, and even a simple zero-signal input termination resistance has some amount of thermal agitation noise.

Both types of noise generator are shown schematically in Figure 1. Here we model a microwave amplifier as an ideal "noiseless" amplifier with a gain of *G*, and a noise generator at the input. This noise generator produces a noise power signal at the input of the ideal amplifier. Although noise is generated throughout the amplifier device, it is common practice to model all noise generators as a single input-referred source. This source is shown as voltage V_i and current I_i.

Noise Factor, Noise Figure and Noise Temperature

The noise of a system or network can be defined in three different but related ways: *noise factor* (F_n), *noise figure* (NF) and *equivalent noise temperature* (T_e); these properties are definable as a ratio, decibel or temperature, respectively.

Noise Factor (F_n): The noise factor is the ratio of output noise power (P_{no}) to input noise power (P_{ni}):

$$F_n = \left[\frac{P_{no}}{P_{ni}}\right]_{T = 290° K} \qquad \text{(Equation 2)}$$

In order to make comparisons easier, the noise factor is always measured at the standard temperature (T_o) 290° K (official room temperature).

The input noise power P_{ni} can be defined as the product of the source noise at standard temperature (T_o) and the amplifier gain:

$$P_{ni} = GKT_oB \qquad \text{(Equation 3)}$$

It is also possible to define noise factor F_n in terms of output and input S/N ratio:

$$F_n = \frac{SNR_{in}}{SNR_{out}} \qquad \text{(Equation 4)}$$

which is also:

$$F_n = \frac{P_{no}}{KT_oBG} \qquad \text{(Equation 5)}$$

Where:

SNR_{in} is the input signal-to-noise ratio.

SNR_{out} is the output signal-to-noise ratio.

P_{no} is the output noise power in watts (W).

K is Boltzmann's constant
(1.38 x 10^{-23} J/°K).

T_o is 290 degrees Kelvin (°K).

B is the network bandwidth in hertz (Hz).

G is the amplifier gain.

The noise factor can be evaluated in a model that considers the amplifier ideal, and therefore only amplifies through gain G the noise produced by the "input" noise source:

$$F_n = \frac{KT_oBG + \Delta N}{KT_oBG} \qquad \text{(Equation 6)}$$

Where:

ΔN is the noise added by the network or amplifier.

All other terms are as defined above.

Noise Figure (NF): The noise figure is a frequently used measure of an amplifier's "goodness," or its departure from "idealness." Thus, it is a figure of merit. The noise figure is the noise factor converted to decibel notation:

$$NF = 10\ LOG(F_n) \qquad \text{(Equation 7)}$$

Where:
NF is the noise figure in decibels (dB).

F_n is the noise factor.

LOG refers to the system of base-10 logarithms.

Noise Temperature (T_e): The noise "temperature" is a means for specifying noise in terms of an equivalent temperature. Evaluating Equation 1 shows

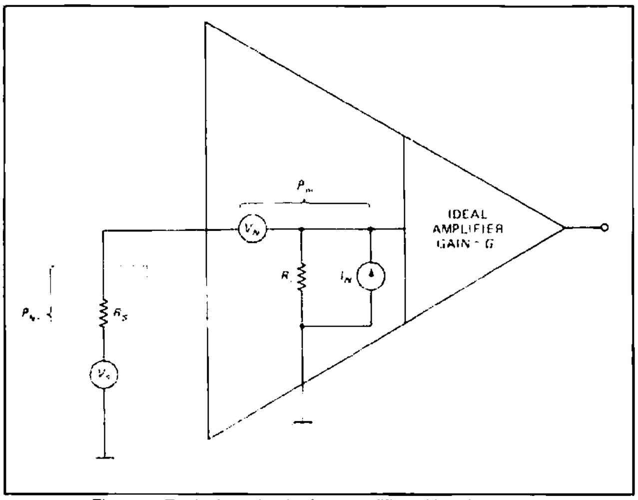


Figure 1. Equivalent circuit of an amplifier with noise source.

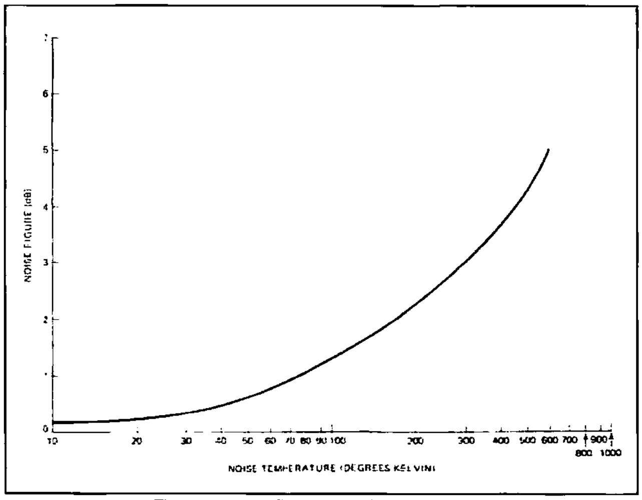


Figure 2. Noise figure vs. noise temperature.

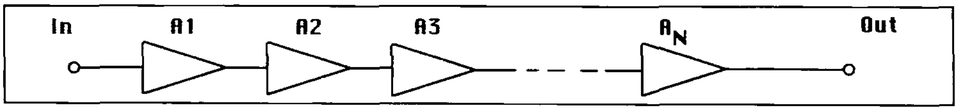


Figure 3. Cascade chain of amplifiers.

that the noise power is directly proportional to temperature in degrees Kelvin, and also that noise power collapses to zero at the temperature of Absolute Zero (0° K).

Note that the equivalent noise temperature T_e is not the physical temperature of the amplifier, but rather a theoretical construct that is an *equivalent* temperature that produces that amount of noise power. The noise temperature is related to the noise factor by:

$$T_e = (F_n - 1)\, T_o \qquad \text{(Equation 8)}$$

and to noise figure by:

$$T_o = \left[\text{Antilog}\left(\frac{NF}{10}\right) - 1\right] KT_o \qquad \text{(Equation 9)}$$

Now that we have noise temperature T_e, we can also define noise factor and noise figure in terms of noise temperature:

$$F_n = \frac{T_e}{T_o} + 1 \qquad \text{(Equation 10)}$$

and,

$$NF = 10\ LOG\left[\frac{T_e}{T_o + 1}\right] \qquad \text{(Equation 11)}$$

Noise figure and noise temperature are roughly graphed in Figure 2.

The total noise in any amplifier or network is the sum of internally generated and externally generated noise. In terms of noise temperature:

$$P_{n(total)} = GKB(T_o + T_e) \qquad \text{(Equation 12)}$$

Where:

$P_{n(total)}$ is the total noise power.

All other terms are as previously defined.

Although the equations tend to show absolute equivalence and convertibility between F_n, NF and T_e, there is sometimes a bit of confusion regarding proper practices for optimizing an amplifier with regard to matching the input and source resistances. There is an optimum source resistance for minimizing input noise power. There is also an optimum source resistance for maximum power transfer to the amplifier (source resistance equals amplifier input resistance). Unfortunately, the two optimum resistances are rarely the same. While impedance matching is useful, some common tactics are not.

A tactic used by some designers is to modify the source resistance by adding a series or shunt resistance to the circuit to bring the total source resistance seen by the amplifier to the optimum value for noise figure reduction. Unfortunately, while this tactic improves the *apparent* noise factor, it actually deteriorates output signal-to-noise ratio. In the case cited, the noise contributed by the added resistor (KTBR) increases input noise to a point that dominates and masks amplifier internal noise. While that tactic appears to improve F_n, it actually does not affect F_n at all, but it does deteriorate output signal-to-noise ratio (SNR_{out}).

Noise in Cascade Amplifiers

A noise signal is seen by a following amplifier as a valid input signal. Thus, in a cascade amplifier (Figure 3) the final stage sees an input signal that consists of the original signal and noise amplified by each successive stage. Each stage in the cascade chain both amplifies signals and noise from previous stages, and also contributes some noise of its own. The overall noise factor for a cascade amplifier can be calculated from *Friis' noise equation. (See Figure 4.)*

$$F_n = F1 + \frac{F_2 - 1}{G1} + \frac{F_3 - 1}{G1\,G2} + \frac{F_4 - 1}{G1\,G2\,G3} + \ldots + \frac{F_n - 1}{G1\,G2\,G3 \ldots G_{n-1}}$$

or, in terms of noise temperature:

$$T_n = T1 + \frac{T_2 - 1}{G1} + \frac{T_3 - 1}{G1\,G2} + \frac{T_4 - 1}{G1\,G2\,G3} + \ldots + \frac{T_n - 1}{G1\,G2\,G3 \ldots G_{n-1}}$$

Figure 4. Friis' noise equation.

Where:

F_n is the overall noise figure of N stages in cascade.

T_e is the overall noise temperature of N stages in cascade.

F1 is the noise factor of stage-1.

F2 is the noise factor of stage-2.

F3 is the noise factor of stage-3.

F_n is the noise factor of the nth stage.

T1 is the noise temperature of stage-1.

T2 is the noise temperature of stage-2.

T3 is the noise temperature of stage-3.

T_{n-1} is the noise temperature of the *(n-1)th stage.*

G1 is the gain of stage-1.

G2 is the gain of stage-2.

G3 is the gain of stage-3.

G_{n-1} is the gain of stage (n-1).

As you can see from Equations 13 and 14, the noise factor or noise temperature of the entire cascade chain is dominated by the noise contribution of the first stage or two. Typically, high sensitivity microwave amplifiers use a low noise amplifier (LNA) stage for only the first stage or two in the cascade chain because that stage dominates all the rest of the chain.

Number 14 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. K0OV
P.O. Box 2508
Fullerton CA 92633

Good Deeds, Good Fun, and Goodwill

For most of us, Sunday, January 29, was a day to have a party at home and watch the Super Bowl. For search/rescue crews and a handful of hams in southern Arizona, it was a test of patience and skills in radio direction finding (RDF).

The night before, a signal had appeared on a non-ham VHF public service repeater south of Tucson. A boy calling himself "Leo" said that he was part of a group lost in the Madera Canyon area north of Nogales. One of the boys had an injured leg, he said. Many agencies, including the Santa Cruz County Sheriff's Department, Santa Cruz County Emergency Services, and the Arizona Department of Public Safety, had responded in full force. The search was called off Saturday night when Leo stopped talking, but he was back on the air again Sunday morning.

By now, officials suspected a hoax. They could not hear the signal on the repeater input. It would be quite unlikely for a civilian to be carrying a radio for this emergency service repeater while hiking, and the signal showed no sign of deterioration due to battery depletion. Furthermore, Leo's answers to questions were vague and sometimes conflicted with earlier statements.

At this point Mac McWilliams, Director of Santa Cruz County Emergency Services, called the Civil Air Patrol. He knew that CAP has equipment and manpower to track emergency beacon signals. (See "Homing In," April 1994.) Bill Croghan WB0SKW of CAP told McWilliams that his agency's RDF gear is specialized for aircraft distress frequencies and thus not usable for this search. Bill then began to call people that he knew could help—ham radio transmitter hunters.

Practice Pays

Every week at El Con Mall in Tucson, about a dozen hams meet for an RDF contest, usually called a foxhunt or T-hunt. In their cars, trucks and vans equipped with RDF gear, they attempt to win by being the first to find the "hidden T" or to find it with lowest

Photo A. Kevin Kelly N6QAB came from Thousand Oaks, California, to be individual winner of the 1991 foxhunt in Portland, Oregon

odometer mileage, depending on the rules set by the hider for that hunt. Typically, two hams form a mobile team.

As a regular Tucson T-hunter, Jerry Clark K7KZ was one of the first to be called by WBØSKW. Jerry immediately phoned his hunting partner Bob Buchanan KA7CCC and began to install his doppler RDF set in his car. "I called the Santa Cruz County Sheriff's Department using a cellular telephone and we were patched through to the deputy in charge of the search," says Bob. "He suggested that we meet at the top of Mount Hopkins."

Bob and Jerry headed in that direction, agreeing that if they found a trackable signal before getting there, they would start RDFing at that time. "We met the deputies near the bottom of Mt. Hopkins Road," KA7CCC continues. "Up to that time we had not heard the direct signal. The deputy got the boy to talk to him through the repeater. We were still unable to hear him on the input, so we concluded that he was nowhere in the search area.

"On a hunch, we decided to drive south towards Nogales and then, if necessary, up through Patagonia and Sonoita. The deputy continued to coax information from the boy and he obliged with numerous transmissions. As we approached Rio Rico, we started to get a strong, unambiguous signal."

At the same time, another team of T-hunters began looking for Leo. Jason Auvenshine N7UGP and Faber Tunison N7ZAZ had also been alerted by WBOSKW. They headed south toward Madera Canyon, listening on their doppler RDF set and also trying to hear the weak 151 MHz signal with their 2 meter beam.

"The directional pattern was not great out of band, but the yagi did well enough to let us know he was south and got us into doppler range," Jason says. "The deputy in the field did a heck of a job communicating with the boy and keeping him on the air. I could tell he was struggling with it."

The two teams continued, unaware of each other's efforts. At 7:30 p.m., Jason and Faber had to stop hunting due to a previous commitment. Moments later, Jerry and Bob pulled up in front of the boy's house, just as the transmissions abruptly stopped.

"We went about two miles to an easy place to rendezvous and called by cell phone to inform the authorities what we found and where they could meet us," says Jerry. "A bunch of deputies showed up, and then an agent from the FCC. I got into the Sheriff's car and Bob got into a car with one of the emergency service workers and we led them to the house."

Three young persons, ages 18, 14, and 13, were arrested and later released into the custody of their parents. "The 13-year-old was doing the transmitting," Jason says. "He was alone in his room when caught, with an eight-channel commercial handheld radio and its charger, which was apparently from a home burglary. The other two teens had been actively involved earlier. The 13-year-old's parents were there and appeared to not be aware of the transmissions."

As you can imagine, the heroic hams received wide acclaim. The County's Board of Supervisors and Emergency Services Department presented Jerry and Bob with plaques. *The Arizona Star* wrote an excellent account of the caper and the usefulness of hams' T-hunting activities. "And a local TV station did an interview," says Jerry. "It was from the angle that if you perpetrate a hoax like this, you're going to get into a lot of trouble."

According to K7KZ, "The agencies were upset because the kids' activities had endangered all the residents of the county by tying up all their resources. They intend to charge them with felony endangerment." KA7CCC adds that two State Patrol helicopters in the search had been forced to land at some very precarious locations on the mountain, risking lives of the crews. He says that there may be attempts to recoup expenses of the search from the family and that the FCC may impose stiff fines.

N7UGP says that ongoing T-hunt experiences made the bust possible. "It was just a matter of following the doppler right to him. On some of our hunts, the hider will do tricks like using a yagi with horizontal polarization and aiming at the mountains to get multiple reflections. When you get a real one like this, it's usually easy."

"Our group has been holding hunts for two to three years now, more or less once a week," says Jason. "We've tracked down a couple of interference sources of the ham nature a couple of times, and we also have ties to people in the CAP who search out locator beacons for downed aircraft (ELTs). For a while, in addition to running hidden transmitters in the ham bands, we would also put a dummy ELT on the test frequency (121.6 MHz) at the hiding site for the CAP RDFers. We would call up the local FAA to say we were going to be doing a drill and get permission.

"I wish we would have had some ready-made organization for events like this, perhaps a telephone tree to call people. I think a lot of time and money on the part of the Sheriff's department could have been saved if we had been able to get our act together and leave Tucson sooner. The Sheriff wants to talk to us about this."

Commendations to all of these Tucson hams for their eagerness to serve. Also, thanks to Nick Ross KO6QD for bringing this story to my attention.

Spanning the Globe

Even though T-hunters in the USA often serve the public like the Arizona hams I just told you about, and despite the fact that some California all-weekend hunts require 300 or 400 miles of driving to find all the transmitters, we still are not considered world-class RDFers by the rest of the world.

In most countries, cars and fuel are relatively expensive, so they aren't likely to be used by the average ham for hobby purposes. Mobile foxhunting can be found only in the USA, England, Australia, and Japan. Everywhere else, it's an on-foot sport, done for its physical fitness benefits. Eastern European schools include it in physical education programs, including hams and non-hams alike.

If you go to a former Soviet Union country, you probably won't hear voices on the 2 meter band. You can count the Russian cities with VHF repeaters on the fingers of one hand. But wherever you go in that part of the world, there is a good chance you can hear the MCW transmissions of a 2 meter foxhunt. Just like other amateur athletes, European and Asian foxhunters like to get together for national and international championships. To this end, a standard set of foxhunt rules has been developed by an International Amateur Radio Union (IARU) committee.

A championship foxhunt course comprises five transmitters in a hilly wooded area. The foxes are spaced such that the round-trip distance to

HAM HELP

Number 15 on your Feedback card

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2" x 11") sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests.

I recently bought a military-type VHF receiver at a sale. There was no manual for it. The following information is on the name plate: "VHF Receiver Model R950R-3 Serial #1 AF 30(635)905 Radio Receptor Co., Brooklyn, NY General Instrument Corp." I believe this set was made in the 1950s. I need a manual and/or schematic for this rig. Do you know where I may be able to acquire one? I will appreciate any information or advice on this. *John J. Weyrauch, Aldrich Rd., R.R.4 Box 416, Norwich NY 13815-9419.*

WANTED: Schematic diagram, parts list, manual, or whatever you may have for a MONARCH Model HAM-2 solid state, 4-band communications receiver. I will pay for original or copies. All replies answered. *Joseph Rubin WB4CBJ, P.O. Box 211-A, Cortez FL 34215.*

I need the schematic and service manual, (or address where I can get these items), for BEARCAT BC 250. I will pay for expenses. *Jim Sampson, PSC Box 1388, APO AE 09720-9998.*

each one in numbered sequence and back to the start/finish line is 5 to 12 kilometers. Each fox transmits for one minute, in sequence, on the same frequency as the others. Smart competitors take bearings on all five foxes as they come on, knowing that if they miss a fox bearing, they must wait four minutes to hear it again. A continuous transmitter on a different frequency at the finish line helps hunters find their way home once they have found all five foxes and marked their cards with the unique punches at each one.

International rules divide competitors into separate categories for seniors (males 18 to 40 years), juniors (boys under 18), women (any age—nobody asks!) and "old-timers." Seniors must find all five foxes. Hunters in the other three categories need find only four. The non-mandatory fox is different for each category, giving different total course lengths.

Two meter foxes use AM with tone modulation. There is also a separate contest in all four categories on 80 meters at a different time. This makes for a total of eight individual and eight team (country) medal sets awarded in gold, silver, and bronze at a championship meet.

The most recent World Foxhunting Championship was last September in Sodertelje, Sweden, about 40 miles south of Stockholm. Lars Nordgren SMOOY reports that there were entrants from Australia, New Zealand, Japan, China, Britain, and South Korea, plus nine Scandinavian countries and nine ex-Soviet block countries. Weather was sunny for only the first half of the 1994 80 meter hunt, then rain set in. It rained throughout the 2 meter hunt, too.

Rules state that hunters must return to the start/finish line within three hours or be disqualified. The record time of an American foxhunter on a course like this is 74 minutes to find all five foxes. Tchermen Gouliev, long considered the "master of radiosports" in Russia, finished the 2 meter course in 47 minutes, 43 seconds, but he didn't win. Janos Orosi of Hungary beat him by five seconds to become the current World Champion Foxhunter. Tchermen and Janos are in the "old-timers" category and had the same placements in the 80 meter event. Russia, Hungary, Slovakia, Ukraine, and the Czech Republic dominated the meet, dividing up the individual and team first places in all categories.

European Foxhunt Championships (for IARU Region 1) are scheduled for September 6-10, 1995, near Bratislava, Slovakia. Australia will host the next IARU Region 3 Championships in 1996. The next World Championships will be in 1997, country not determined yet.

Where's the USA?

It's time for RDFers in North and South America to get involved with world-class foxhunting. Lars and other organizers want to see hams from the USA at upcoming championships. We are going to need lots of practice and competitive experiences. How about putting on a radiosport-type foxhunt at your club's next picnic or barbecue in the park? Maybe the next Foxhunting World Champion is in your town, just waiting to be discovered.

To my knowledge, only one formal international foxhunt has ever been held on US soil. It was put on by the Friendship Amateur Radio Society (FARS) of Portland, Oregon, in May 1991. FARS is the result of a Sister Cities arrangement between Portland and Khabarovsk, a similar-sized city in Asiatic Russia.

The hams of Khabarovsk received a delegation of Portland amateurs in 1989 for a series of radiosporting events, including a European/Asian style foxhunt. Portland reciprocated by putting on the second Friendship Radiosport Games (FRG) in their city two years later (Photo A). See the September 1991 "Homing In" column and "Showdown in Portland" in the November 1991 issue of *73 Amateur Radio Today* for my firsthand reports on FRG-91.

Victoria, BC, Canada, another Khabarovsk sister city, hosted the next FARS gathering in 1993 (Photo B). Now the Games were becoming an international event, with hams from the USA, Russia, Japan, and Canada in attendance. See the October 1993 "Homing In" column for all the details of FRG-93.

This year, it's the Russians' turn to host the Games again, and you're invited. FRG-95 is by no means a World Championship, just an opportunity for hams across the world to get together for camaraderie and radiosports. If past Games are any indication, there will be only one foxhunt, on 2 meters. It will not be broken into categories of contestants. Expect men, women, boys, and girls to compete on equal footing. Average age of the Russian team last time was 40, and you won't be up against any Olympians.

This year's Games are scheduled for August 11 to 13, but the FARS excursion to Khabarovsk encompasses two full weeks of sightseeing and cultural events, beginning August 4. You will stay in the homes of Khabarovsk's hams, just as they stayed at homes in Portland and Victoria. The organizers hope to attract competitors from the USA, Canada, Japan, India, and China.

Although it is an important commercial hub on the Amur River, Khabarovsk is a city of simplicity. According to *Alaska Airlines Magazine*, "The shops are small and simple, the streets filled with people toting bags, pulling carts. An essential center of family activity is the small gardens that surround each home. Every square foot of earth within the fences is planted with something."

Khabarovsk is less than 500 miles from Sapporo, Japan. The group's cost for transportation to and from Russia (departing and returning from Seattle) will be about $1200 per person. Other expenses will run about $250 per person. Waivers and financial aid may be available to those deemed by FARS to be official US delegates.

For hams who love transmitter hunting and international travel, this is an excellent opportunity. If you are truly interested in being a part of FRG-95, get started on your passport preparations and write to Rene Berblinger KX7Z at FARS/Portland, PO Box 13344, Portland, OR 97213. Rene is assembling the US delegation and will submit your name to get your Russian visa issued. Don't delay—paperwork must be done well in advance of travel.

Let me know your plans also. Remember, my new Internet address is simply HomingIn@aol.com. My CompuServe ID is 75236,2165. If you don't have E-mail, write to the address at the beginning of this column.

Photo B. Alex Savin UAØCDX of Khabarovsk took individual honors at the FRG-93 foxhunt in Victoria, British Columbia.

Number 16 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Mexico, Israel and Russia

Two new hamsats were scheduled for launch on March 28th. UNAMSAT-1 from Mexico and TECHSAT-1 from Israel may now be in orbit. Launch was to be from the Plesetsk facility in Russia. Both satellites are of the digital variety, but offer some unique features that set them apart from the current digital fleet.

UNAMSAT-1

Built at the Universidad Nacional Autonoma de Mexico, by the PUIDE (Programa Universitario de Investigacion y Desarrollo Espacial) group, UNAMSAT-1 is a microsat clone with a fascinating experiment in the TSFR slot. The first microsats were launched from French Guiana five years ago. They are small cubes, 25 cm on a side, weighing about 10 kg each, with five stacked modules. Four of the modules contain standard components common to all, including a 2 meter receiver, battery charge regulator, computer and a 70 cm transmitter. The fifth module or slot has been called the TSFR, or "This Space for Rent."

The UNAMSAT-1 TSFR consists of a 100-watt radar transmitter on 40.997 MHz. It sends short pulses and then listens for echos from ionization trails caused by meteors as they burn up in the atmosphere. The returning echos are digitized by the onboard computer and downlinked as data files on 70 cm for study. The 41 MHz transmitter is licensed by Mexico according to the ITU (International Telecommunications Union) frequency allocation listings.

The goal of the experiment is to identify meteors that have velocities greater than 72 km/sec. This is the solar system escape velocity. Meteors traveling faster are from outside our system. To identify these meteors, detailed spectrum analysis is performed on the downlinked data. Velocities and trajectories can then be determined.

The radar transmitter consists of a crystal-controlled exciter running 220 mW and a high efficiency (92%) power amplifier. Modifications were made to the standard satellite power supply to provide the current necessary for the pulse transmitter. A switching power supply charges a bank of tantalum capacitors to 40 volts DC. The satellite's power supply usually only provides 10 volts. The transmitter's power amplifier operates from the charged capacitor bank for the duration of a radar pulse. The bank is then recharged between pulses without straining the 10-volt supply line.

The radar receiver has a GaAsFET (Gallium-Arsenide Field Effect Transistor) front end to a double balanced mixer, bandpass filter, IF (Intermediate Frequency) amplifier, phasing network and summing amplifier. The mixer samples the crystal oscillator to obtain true Doppler shift information on incoming signals. The output of the receiver is sent to a 68HC805B6 microprocessor for analog-to-digital conversion. The results are then sent to the satellite's main CPU (Central Processing Unit) for encoding and subsequent transmission to the ground.

Both the receiver and transmitter share the same antenna, a canted dipole, through a hybrid circuit that provides sufficient signal isolation. The antenna supports on the microsat were braced to support the larger elements needed for 41 MHz.

The TSFR of UNAMSAT-1 represents a significant accomplishment. The radar system with controller were all packed into one module, and it works. Ground tests in the fall of 1994 performed better than expected. Meteor reflections were detected, digitized, stored and sent as files by the satellite. Programs will be available after launch to aid interested amateur enthusiasts with decoding endeavors.

UNAMSAT-1 also has the usual store-and-forward capabilities of the other microsats. Operation is at 1200 bps (bits per second) using FSK (frequency-shift keying) on any of the uplink frequencies: 145.831, 145.851 or 145.871 MHz. The downlinks are also 1200 bps but use PSK (phase-shift keying) on 437.206 or 437.064 MHz.

The eight students from UNAM involved with satellite construction, and program manager David Liberman XE1TU, traveled to Russia in early March to prepare for launch. The Plesetsk launch site is about 700 km north of Moscow.

TECHSAT-1

Built at the Technion in Haifa, Israel, TECHSAT-1 is Israel's first amateur radio satellite. The spaceframe shape is similar to a microsat, but has nearly eight times the volume and weighs in at 50 kg, five times that of UNAMSAT-1. TECHSAT-1, also known as Guerwin-1, has backing from academic and commercial interests in addition to the active participation of AMSAT-Israel.

The satellite has a three-axis stabilization system using computer-controlled electromagnets. Early tests at the Technion proved the magnetorqueing system to be quite effective. Complete stabilization of the spaceframe was achieved within three hours. In orbit the satellite will be pointed earthward at all times. A horizon sensor will aid the magnetorqueing control process.

One reason for the orientation system is to keep the onboard camera aimed properly. Like previous UoSATs and Kitsats, TECHSAT-1 will take snapshots of the earth for downloading to stations on the ground. A new algorithm for image compression will be used. Current files from the other imaging hamsats run about 300 KB each. TECHSAT-1 will precompress the data to make smaller files for transmission to earth.

The radio communications components of TECHSAT-1 are digital. It will run 1200 bps PSK like other microsats, but will also be capable of 9600 bps FSK like UoSAT-OSCAR-22, Kitsat-OSCAR-23 and -25. Store-and-forward, multi-user operation will be the primary amateur radio activity. Of the 20 watts available to the payload, 10 will be required for housekeeping circuitry.

In addition to the usual 2 meter uplinks and 70 cm downlinks, TECHSAT-1 will also carry a 23 cm receive system. The four 2 meter uplinks are 145.850, 145.890, 145.910 and 145.930 MHz. The 23 cm uplinks include 1269.700, 1269.800, 1269.900 and 1269.950 MHz. The two downlink frequencies are 435.225 and 435.325 MHz. For those who have dusty 1.2 GHz satellite rigs (since the loss of Mode L on AMSAT-OSCAR-13), there may soon be a great reason to get back in the microwave transmission business.

The Orbit

The launcher for both satellites is to be a Russian START rocket. The proposed orbit is 670 km in altitude and not sun synchronized. The inclination is estimated at 75.4 degrees with very little eccentricity. Coverage will be similar to UoSAT-OSCAR-11. TECHSAT-1 and UNAMSAT-1 will have orbits about 100 km lower than U-O-22. For ground stations, this means four to six passes a day, 9-13 minutes in duration. For analog transponder satellites this is low and reminiscent of Shuttle chasing, but for digital satellites it's enough time to collect up to 400 KB of data at 9600 bps on every pass.

Waiting

Unlike RS-15, which was available for amateur use within hours after launch, the new additions to the hamsat group will not be released until ground control stations have fully tested the onboard systems.

Testing UNAMSAT-1 may take a few weeks. After launch, the team from Mexico is scheduled to travel back to Moscow. There they are to do initial spacecraft checkout from the Moscow Aviation Institute. Later, they will return to Mexico City to complete the process. The radar experiment will be of prime interest to the satellite builders. It is a first for amateur radio satellites and has great potential.

Early reports from Israel indicated that the ham radio operation of TECHSAT-1 would be delayed for up to six months after launch. Recent information from Haifa now states that the delay may be three months or less. Testing of all the experiments may take some time. Frequencies outside the amateur bands will be used for these tests. When the satellite is finally released for amateur use, a certain portion of its time will be spent in commercial and academic service. A schedule is expected.

Both the Israeli and Mexican teams are interested in reports from hams monitoring the telemetry in the early days of the new hamsats. If no delays occur, they should be in orbit now. Telemetry reports for UNAMSAT-1 can be sent to XE1TU@amsat.org via the Internet. Techsat-1 reports go to 4X6EM@tx.technion.ac.il.

More Information

Late-breaking hamsat news can always be found on the HF AMSAT nets, via packet and on the Internet. Another source is the Houston Area AMSAT Net. This net meets every Tuesday night at 10 p.m. Central Time on the 147.10 MHz WD5BDX repeater. It is also uplinked to Telstar 302, transponder 21, 5.8 MHz audio subcarrier. From there the net is retransmitted on VHF and UHF repeaters around North America. It can also be heard on 160 meters AM on 1860 kHz. Check-ins from remote (non-Houston) locations are by phone and everyone has a great time. See you on the net.

Number 17 on your Feedback card

PACKET & COMPUTERS

Jeffrey Sloman N1EWO
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Well, here I am again. Thanks to all who wondered where I went, I am glad to know I was missed. Life here has been chaotic for the past few months. It included the birth of son number two, Dov Zalman, who spent a week in the hospital at 10 days old. Not to worry, he is a fat healthy baby today. A touch of pneumonia and about $12,000 in medical care later he is back to normal. Many other things have been going on here—some of them even ham-radio related.

IndyGate

Soon, Indianapolis (my home town) will have its first AMPRnet (the amateur radio portion of the Internet) gateway. This machine will link hams with ordinary 2m packet stations to the world via the Internet. Those that install and learn to use TCP/IP software—such as the JNOS version of Phil Karn's KA9Q NOS, which will power the gateway—will get an even more powerful connection. By the time you read this, IndyGate should be on the air. Next month, I will tell you exactly how you can get involved in TCP/IP over amateur radio—and, finally, how you can definitely get the JNOS software and documentation.

> **"Even for most of those who use the Internet with ham radio, just what a gateway does is a mystery.**

What is a Gateway?

Even for most of those who use the Internet with ham radio, just what a gateway does is a mystery. To have some understanding of what a gateway does, you'll need to have a mental picture of how TCP/IP works. TCP/IP, which stands for Transmission Control Protocol/Internet Protocol is a "suite" of rules and programs that let computers exchange data on the Internet. For the sake of our discussion here, we only need to consider the structure of an IP "frame."

A frame in networking is a package of data, which has a "header"—the first part of the frame—containing data needed to handle the frame. Sometimes, frames are referred to as "packets." This is not technically correct, but it is common usage. Packet radio gets its name because of its use of packets—AX.25 is a "packet switched" protocol—but even there packet and frame have distinct meanings. Suffice it to say that people usually mean frame when they say packet.

Frame headers contain different information, depending upon the protocol they adhere to. But, in any case, where the protocol is designed to allow more than two "nodes" (amateur stations in our case) to communicate, the header must contain "addressing" information. This leads us to a convenient analogy—a letter. Think of the frame as an envelope. You are all familiar with the "protocol" for addressing a letter. On the frame (envelope) you include addressing information. The destination address (in the center of the envelope—and nowhere else if you want that letter delivered), and the origination address (return address in the corner). This information is placed in particular spots, and the Post Office looks there to find where to send the letter, while the recipient looks at the return address to reply.

In the data frame case, the header is laid out in a particular order: the first x bytes are destination, the second x bytes are sender, etc. The machine looks at the header and figures out where the frame should go. The letter inside the envelope is the data you want to send, and the IP frame has a "field" (a specified portion of the frame) to handle this as well.

Now with this picture—more or less—firmly fixed in your mind, think about this: What if you were afraid that people seeing your letter's envelope could tell who you were sending mail to? I know this sounds a little paranoid, but let's put it in ham radio terms. What if there were somewhere you could send a letter, so that when your letter arrived it was immediately opened and read on the (ham radio) air? What if the receiving station made no distinction about where the letter came from, instead just assumed that if it arrived at that address it must be OK to read on some amateur frequency?

Well, now you can see that you might want the address of this mythical location secret—to prevent unlicensed individuals from operating amateur transmitters. Well, you say, why can't they just check if the letter is from a ham? Good question—but it would take too long. Too many hams, not enough time. So what can we do to make this arrangement safe from non-licensed individuals who might want to access it? One thing is to hide the address of the station that broadcasts received messages. Just how can we manage to address an envelope in such a way that it will get where we want, but not let anyone reading it know where that is?

Encapsulation

One of the features of the AMPRnet that keeps it safe from non-ham access is called encapsulation. This technique is really very simple, and can be explained by continuing our Post Office analogy. What we do is get a ham to agree to receive mail for the transmitting station. When the mail is received there, he can check it against a much smaller list of hams authorized to mail letters to him. In other words, he is able to authenticate the fact that the sender is a ham, because the ham has registered himself prior to the mail being sent. Not all hams, mind you, just the ones he is willing to handle traffic for. He is our "gateway" to the transmitting address. Now, he is not responsible for delivery to just one address that can handle ham traffic, but for many sites all over the world. How can he tell where your traffic should go?

Opening the Envelope

When the mail arrives at the gateway address, the other envelope (frame) is opened and discarded. Make a guess about what is inside before you read on. If your guess is another envelope, you are right! This envelope, though, is addressed to our transmitting station and is hand-delivered by hams sworn to secrecy about the real location (address) of our transmitter. When the envelope (frame) arrives at the transmitter site, it is opened and processed.

If you understood that, you understand encapsulation and why we need gateways. Traffic on the Internet is visible to many people for various reasons. You cannot be sure who will see where your data is going. If the actual address of a radio-connected amateur resource became known, it might lead to the use of a transmitter by an unauthorized person. So we use IPIP encapsulation; that is, we wrap an IP frame destined to a ham address in an IP frame headed for a "normal" Internet address. The machine at the "normal" address detects that the frame is encapsulated, and extracts the amateur frame from inside. It then sends the frame on the "private" amateur network by delivering directly to the appropriate address. The point is, when amateur traffic moves on the Internet proper, it is hidden inside "normal" Internet traffic. This is, of course, not the only security on the AMPRnet. It would not be sufficient.

> **"The point is, when amateur traffic moves on the Internet proper, it is hidden inside 'normal' Internet traffic."**

The Great Internet Survey

The time has come to make a survey of Internet use by readers of this column. I have two goals in mind. One is to see how many of you are using the Internet, and how. The other is to compile a list of ISPs (Internet Service Providers) from across the country so I can answer the many queries I get concerning getting connected. The questions are in the sidebar on this page. E-mail the survey information to N1EWO@IQUEST.NET. Make the subject of your message: *73* Internet Survey. You do not need to reproduce the questions, just put the number in front of your answer.

Thanks for taking the time to complete the survey. I hope to hear from you soon. 73 de N1EWO

Internet Survey

1. What is your call?
2. Do you run TCP/IP on your packet station?
3. If yes to 2, which software/version?
4. What is your AMPRnet address? (or "none".)
5. What is your name?
6. What is your Internet mail address?
7. Who is your Internet provider?
8. What is the monthly cost for a SLIP connection? (or "don't know".)
9. On a scale from 1 to 10, how would you rate the service you have received?
10. Would you recommend your provider to a friend?
11. What is the provider's service area?
12. What is the Internet provider's E-mail address for information?

Please E-mail your answers to N1EWO@IQUEST.NET.

Number 18 on your Feedback card

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

SWR Primer for VHF Through Microwave

SWR? Sure, you say, I know how it works. A low SWR makes everything work just fine. But as frequency increases are we still comfortable with different measurement techniques at these higher frequencies? I am sure we are all familiar with matching antennas to minimum SWR in the low VHF-to-UHF frequency ranges (146 to 450 MHz). I am presuming that you have similar amateur-type SWR measuring equipment to what I use for frequencies below 500 MHz. When used above their intended frequency range of operation, these instruments give readings that are highly suspect, or even give gross errors. What then are the acceptable types for different frequencies of operation?

The basic SWR meter used in these descriptions is a Swan Electronics dual SWR bridge that I obtained many years ago. It was intended for operation in the 2 to 150 MHz frequency range. The circuitry for this type of meter is shown in Figure 2. For the time being let's describe a single meter device and its circuitry. The basic bridge is balanced with two coupler arms, one going left and one going right in respect to the termination resistors.

Both parts are connected to diodes for RF rectification and the outputs of the diodes are bypassed to ground with a capacitor. The detected RF at this point is converted to DC and is displayed on a small mA meter for measurements. For best results, each arm of the bridge should be matched exactly, not only in construction but in component part selection.

Well, now you have this SWR meter and you want to know just how good your meter is. What can be done to prove how good and to what frequency its measurements are accurate? What instruments do we use to make sure the simple SWR bridge is even telling us the truth? This and other questions are the topic for this month's column. First a little set-up discussion on SWR.

SWR

The benefit of having devices perform with minimum SWR is the same at any frequency of operation. A good match between equipment that is connected together determines how much power is delivered to a load and not wasted. If we are off (mismatched), lots of power can be wasted in an improper impedance match. SWR does not only apply to the transmitter and antenna system, but to interconnects between circuit modules like mixers and RF preamplifiers as well.

In electronic circuitry most circuits are interconnected with 50 ohms because it is convenient and easy to use. Coaxial cable is available for this impedance to make interconnects simple, with appropriate connectors. Having the input and output of a device matched to 50 ohms allows an easy transfer of other replacement units or simplifies trouble-testing, as all devices, including the test equipment, are the same impedance: 50 ohms.

Usually these modules are formed together into a much larger circuit all interconnected to form a converter or system. Using circuitry in this fashion, compared to a single large circuit integration, might be nice in commercial applications, but in amateur systems we never seem to reach the final stage of perfection. We are always modifying our circuitry to suit our changing needs. Without interconnects this modification would be nearly impossible.

Modules that are part of an entire system lend themselves to easier repair. In most amateur microwave systems this is the method of construction instead of a single monolithic structure for a microwave transceiver. I like to refer to this type of construction as "Microwave Building Blocks."

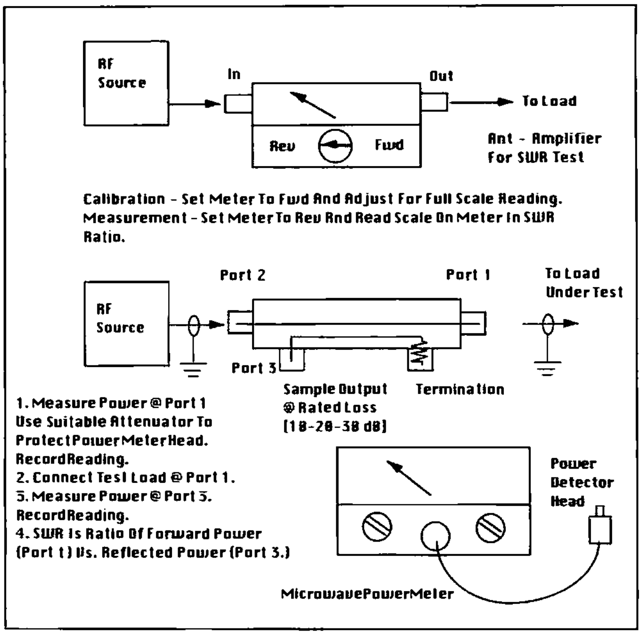


Figure 1. Basic SWR indicator vs. directional coupler.

Matching or minimizing SWR improves circuit operation and reduces excess loss. In some applications it is desirable to make a wide frequency matching circuit. This type of match or load is usually done in its simplest form, a "T"-type attenuator. This is constructed with three resistors in a "T" configuration, and forms a bulk forced resistive matching scheme to terminate a device. To test this match, an SWR meter of some sort is needed and measurements need to be made to test the circuitry. So much for modules; let's get into the meat and potatoes of just what is going on with SWR measurements and how to test your SWR meter at different frequencies.

SWR meters, bridges, or directional couplers are all the same in principle, the difference being in the frequency they are made to operate at. Almost all units employ an internal diode to detect a portion of *directionalized RF power*. The output of this detector feeds a calibrated indicator to determine circuit performance. Did I say an SWR meter or bridge is similar to a directional coupler? Yes; you bet. However, the directional coupler is only a portion of an SWR meter system and normally it can be used for other things. If you look at a schematic diagram of an SWR meter circuit, the portion of the RF pickoff is actually formed by a *directional coupler* sampling the RF. See Figure 1.

The description In Figure 2 is applicable to either single or dual SWR meters or directional couplers. Many SWR meters utilize two diodes to provide detection and display to two different indicators at the same time, one for forward power and the other for reflected power. One half of the circuitry is used when only a single meter is used with a reversing switch, as shown in Figure 1. By using two direc-

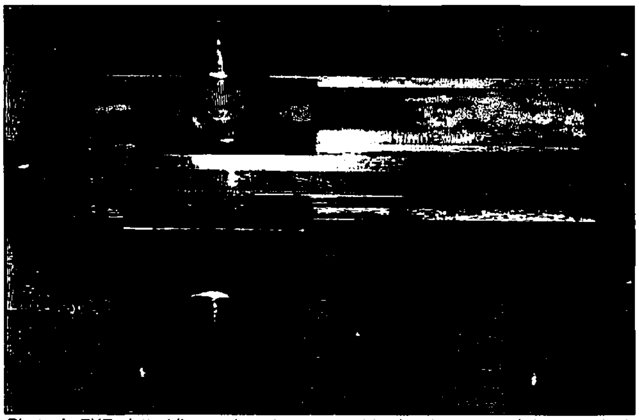


Photo A. FXR slotted line and carriage assembly showing external detector diode (coaxial) used for RF detection.

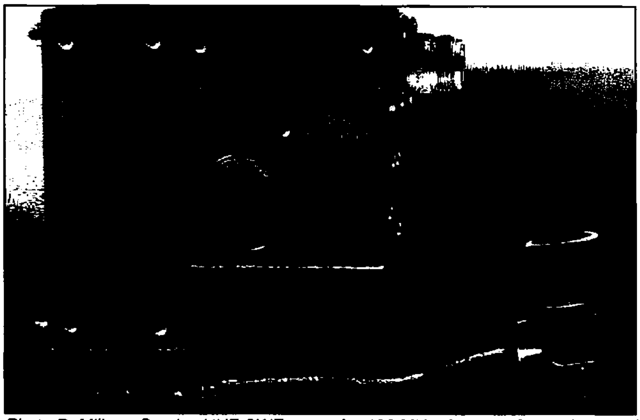


Photo B. Military Surplus UHF SWR meter for 400 MHz, 25 watts forward, to read reflected push reflected power button (black).

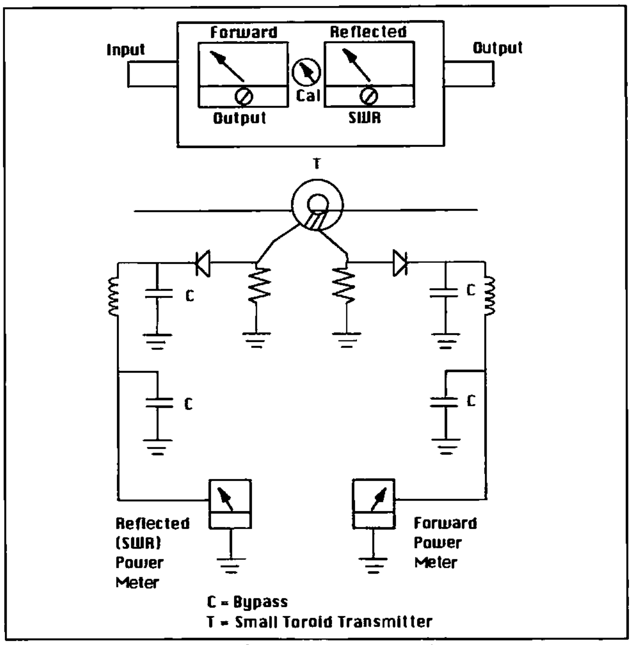


Figure 2. Basic dual indicator SWR bridge circuitry. Advantage: It's easy to use. Disadvantage: It's limited to low-frequency use only (not usable above 200 MHz).

tional couplers connected as in Figure 3. the operation is the same as a similar lower frequency dual-metered SWR meter.

The directional coupler shown in Figure 3 has three ports: 1. 2. and 3. Port 1 is usually the input; Port 2 is the output; and Port 3 is the test or coupled port. When RF is applied to Port 1 it flows to Port 2 with very minimal loss. It's essentially a direct section of coaxial cable or waveguide in the very high microwave frequencies. The power is coupled into a branch arm of Port 3 through a small slot in the outer shield between Ports 1 and 2, and the termination and Port 3. The amount of coupling available at the sample port (Port 3) is indicated on each coupler and expressed in a dB loss factor like 10 or 20 dB. The coupled loss is determined by the opening (size) of the slot coupling both transmission lines. "The longer the slot length the lower the frequency of the directional coupler" is a basic rule. It's kind of like looking at two pieces of coax cable connected together with a hole in each shield and the two cables joined (insulated) at the common opening in the shields for cross-coupling.

If we assume a 10 dB directional coupler, forward power measured at Port 3 will be 10 dB less than the actual power that is applied at Port 1. If the load at Port 2 is a good match, little or no reflection will feed back into Port 2 from the termination at that port. If power does feed back (poor SWR) it will be absorbed in the termination at the end of Port 3 and not interfere with the forward power in the coupler. (The coupler in this example is normal, not reversed.) The basic concept to remember is that *the directional coupler has directionality*, the ability to discriminate between forward and reverse power.

Let me state that again another way. If power is fed at the same end as the termination on a single directional coupler (Port 1), the termination end of the coupled arm will not see forward power but rather a detector connected at the opposite end (Port 3) *will only see forward power.* Now reverse the above coupler and add a second directional coupler to the first setup to form a forward and reflection coupler. Let's look at what is happening on the first coupler. The same rule applies to both couplers with the exception that the first coupler is reversed.

When forward power flows (second coupler) from Port 1 to Port 2 there is very little loss (0.3 dB). Power from Port 1 couples into the directional arm of Port 3, all forward power minus coupling loss flows into Port 3. All other power is output to the load or antenna at Port 1. As far as coupler 1 is concerned (Figure 3), just the reverse is true. Because the main feed is on Port 2 to Port 1, Port 3 will only see reflected power.

Now the magic—because the directional coupler is directional. Any power that is not absorbed in the main load, an antenna termination or whatever, in Port 1 of coupler 1 (Figure 3) will be reflected back towards Port 1 and is coupled into Port 3. At Port 3, coupler 1 power measured there will be only reflected power components less the coupling loss. With the forward power known you can calculate your SWR ratio using the just-calculated reflection power and obtain the SWR with this directional coupler method.

Now that we have gone through this directional coupler magic, have I tricked you from the basic SWR meter circuit? No way. Take a look at the circuitry as it was developed, using a slow, meticulous, hopefully lucid thought pattern. Doesn't the circuitry look quite a bit like the basic SWR meter circuit found in the simple SWR meter for 2 meters using two inductors and individual diode detectors? Of course, the meters and detectors are missing, but the circuitry is the same, just adapted to different frequencies.

The reason we don't see directional couplers at lower frequencies is that if they were made with transmission lines they would be *too large.* Normally, transmission line directional couplers are used from 1,000 MHz to well over 24,000 MHz. Just observe the frequency of use marked on each coupler, along with its coupling loss and decide if it can be useful for your needs. A basic rule of thumb: large couplers, low frequency; small couplers, high frequency.

Calibration of SWR Meters

How, then, do you check an SWR meter to see if it is telling you the truth? There are two ways. One is to duplicate different mismatches with carbon resistors to cause an SWR meter (reflection) to indicate, and the other is to make an SWR reading on the SWR meter itself. First, let's use the carbon resistors to calibrate the meter scale of an SWR meter reflected power meter scale.

With a 50-ohm dummy load or 50-ohm resistor of suitable power capability there should be a perfect or 1:1 SWR reading, indicating a perfect match, or minimum SWR. Now, if we replace the dummy load with resistors of different values we can simulate a different amount of SWR reflected power and read the same on the meter if all is operating well. For a 2:1 SWR, use a 100-ohm termination; for 3:1, use 150 ohms; and for a 1.5:1 SWR, use a 75-ohm resistor. Each time set forward power to full scale and then read reflected power readings.

If you want, for fun, do an SWR on the SWR meter by placing it in line with a termination on the output and making an SWR reading on the SWR meter. See if the meter circuitry is a good match to 50 ohms and does not upset the transmission line by having a poor SWR by itself. In commercial use we term this: "What is the return loss of the device (SWR meter)?" A return loss of better than 20+ dB is considered very good. What does return loss signify? Well, it's just another way of stating what the SWR of the component or device is. A 20 dB return loss is the same as an SWR reading of 1.2 to 1. That means that the device (SWR meter) is not capable of resolving to finer measurements of less than 1.2 to 1. See Table 1 to compare return loss to SWR measurements.

If a single directional coupler is used for forward measurements and then reversed to read reflected power, dissimilarity in different couplers can be eliminated. The single type of meter is most accurate in that only one diode and the same circuitry is used to make both readings, so the chance of difference in circuitry is minimum to each reading.

With a two-diode or two-meter indicator, two different circuits are calibrated to display readings. Imbalance or differences in unmatched diodes will give erroneous results. The dual circuitry should look and be electrically "twins" to provide meaningful readings. These units are not calibrated as time goes on—they're relied on as is. They might be just fine, but to be sure, check them.

There is little difference between making an SWR reading at 2 meters and at a microwave frequency. In each case, some form of test configuration of the test setup must be used. The biggest problem between VHF and microwave SWR meters is cost. The SWR meter for use at 2 meters is quite

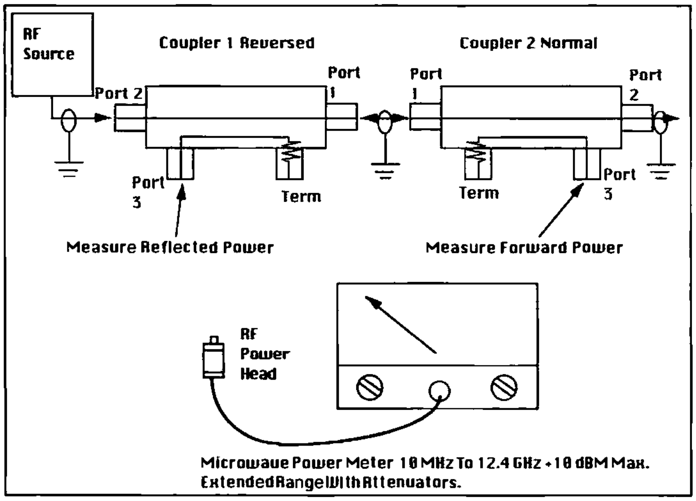


Figure 3. Two directional couplers used for SWR measurements.

inexpensive compared to a microwave SWR system because of simple bulk supply and use. Manufacturers can sell more SWR meters for VHF than they can for microwave use.

The circuitry used in a VHF SWR meter is somewhat large compared to a microwave SWR meter. With a VHF device at 146 MHz, a quarter wavelength is about 19 inches long. Circuitry should be a small fraction of this wavelength factor to be effective. Remember, it's OK to use square corners and make long wire runs at 80 meters; however, the same type of construction at 2 meters is a death sentence, and at microwave death was a hundred years ago.

The same analogy applies to a comparison between 2 meters and 1296 MHz. As frequency increases circuit size and interconnections to the RF circuitry must decrease, keeping it small in relation to the wavelength factor (2 meters/146 MHz = 20.27 inch, 3/4 cm/1296 MHz = 2.28 inches). As you can see from the two quarter wavelengths being compared there is almost a 10 to 1 difference in wavelength factors for component selection.

Errors can jump up when components used in construction become large compared to the wavelength factor. For example, a good selection (component size considerations) for 1296 MHz would be to select a chip (leadless) resistor rather than a 1/2-watt carbon composition to terminate a circuit. The difference between the two resistors is the leads of the 1/2-watt resistor, which at 1296 MHz becomes reactive and looks like an inductor in series with the resistor element.

Low frequency SWR meters can use these components with little detriment and perform quite well. As frequency increases, more expensive component parts are required to be able to make accurate measurements.

Return loss is like SWR, a ratio of forward power to reflection power, and is expressed in dB. The reflection product is the power bounced back from the load due to mismatched impedances at the load. If everything is perfect (assuming no loss or reflections in the SWR bridge), all power from the source will be absorbed in the load after passing through the SWR bridge. Now, the world is not perfect and some loss does exist in the bridge. What these imperfections cause in respect to the perfect condition is the reflection of some RF power back to the source. How much depends on how good or poor the match is.

In commercial calibration the return loss measurement is usually made with directional couplers and level-sensitive sweep oscillators to test the device in question. In most amateur applications a directional coupler operating at the fixed frequency of operation will produce accurate single-frequency readings.

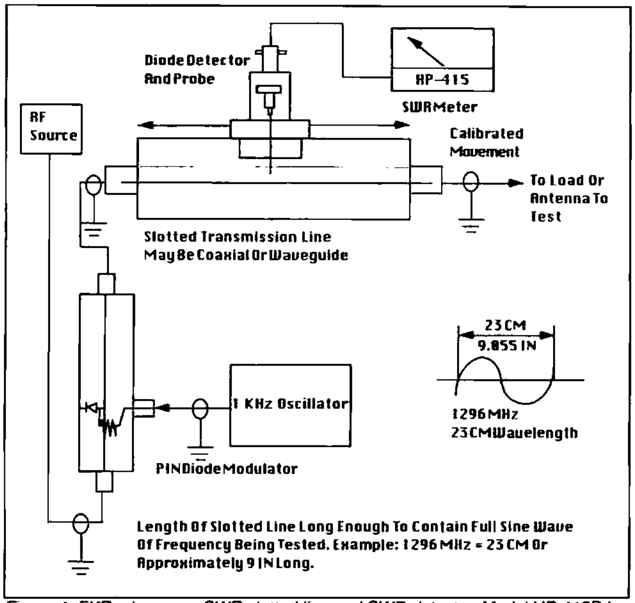


Figure 4. FXR microwave SWR slotted line and SWR detector. Model HP-415D basic setup with HP pin diode modulator. Slotted line method of SWR measurement.

Mail Box Comments

Jack Lindauer WA6EFM wants it to be known that he is putting together a Swan 250 6 meter transceiver users' group. He wants to exchange information on the use of this specific transceiver, including modifications and basic information. To contact Jack, write or call: 18881 Brymer Court, Northridge, CA 91326: (818) 831-0515.

I just received a brief letter from Marcelo Bonotto Chrispim, Curitiba PR Brasil. Marcelo slates that he is an avid reader of *73* and of this column, but is having a very difficult time obtaining information, articles, and products and components for microwave ham-band construction projects. Marcelo is interested in building oscillators, synthesizers, preamplifiers and mixers. Components he is interested in include Teflon PC board and SMA connectors, in addition to newsletters and products that are available for the amateur microwave enthusiast.

This letter points out to me very strongly that we in the U.S. live in a land of abundance. It's probably not the abundance that we pictured, but when we think of what we have available in comparison to other amateurs in the world, and what great efforts they go through to assemble components and material for a project, I think they deserve a very big compliment for their love of amateur radio and construction in general. Sure, we can go to the local Radio Shack and listen to the sales counterperson say, "Microwave, what's that?" but still material is fairly easy for U.S. amateurs to obtain.

In response to Marcelo's query I have sent him information on some of the kits and PC boards that I have available, in addition to the names of other manufacturers and microwave groups that publish newsletters to keep us informed about our amateur activities in the microwave realm. Included is the North Texas Microwave Society, c/o Wes Atchison WA5TKU, Rt. 4 Box 565, Sanger, TX 76266. Dues are $12 a year and they issue a newsletter six times a year.

In response to many queries on surplus material that I have available, here is a short list of microwave related items: Qualcomm synthesizers for 2.6 GHz that can be converted to run PLL with a 10 MHz clock from 2.1 GHz to 2.6 GHz in 2.5 MHz step sizes, output power +8 dBm, cost: $15 each; Qualcomm multipliers 2.x GHz times 5 normally to 13.1 GHz, mod to times 4, will multiply synth at 2.555 GHz (x4) to 10220 MHz power output +7 dBm, cost: $15 each; 1 watt FET amp PC board at 14 GHz mod to 10368 MHz, -5 dBm in, produces 1W out with retuning board, cost: $25 each; 12 GHz receiver mod to three-stage preamp at 10 GHz, cost: $12 each, old style; new style RF preamp less mods will operate at 10 GHz w/27 dB gain 3 NF, retuneable to 1.1 dB NF, cost: $30 each. Prices are plus postage ($3 min.); sales tax for California destinations.

Well, that's it for this month. As always I will be glad to answer questions concerning this month's topic and related amateur microwave subjects. Please send an SASE for a prompt response. 73 Chuck WB6IGP.

SWR Reading	Return Loss
1:1	66 dB
1.1:1	26 dB
1.2:1	20 dB
1.3:1	17.7 dB
1.4:1	15.5 dB
1.5:1	13.9 dB
2:1	9.5 dB
3:1	6 dB

Table 1.

ATV

Number 19 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Danish 10 GHz ATV

This month I'd like to bring you some ATV news from Europe. A very active group from Denmark has accomplished some remarkable ATV DX contacts on the 10 GHz band this past summer.

The First Test

During the Danish Microwave Week (mid-June 1994), numerous stations were set up over the region with voice contacts being made on 10, 24, 47, 76 and 145 GHz. In order to try something new, Bjarne OZ1UM and Soren OZ3VC brought along equipment for 10 GHz ATV. The transmitter consisted of a frequency-modulated DSO (directly on 10.4 GHz), followed by a 500 milliwatt power amplifier stage (sound was transmitted with a 5.5 MHz subcarrier). To receive the picture, they used a modified down-converter from a satellite TV receiver with a noise figure of approximately 1 dB followed by an IF stage and demodulator. The dishes used were made by Procom.

The first tests were made just prior to the activity week over a 19-mile (31-km) path with excellent results. During the actual event (6/12/94) they attempted a contact between OZ1UM in Spodsbjerg and OZ3VC in Skagen, a distance of 129 miles (209 km). Unfortunately, conditions were not good enough to establish a contact and OZ3VC moved his station to a closer site at Trehoje on Mols. This time, a very successful ATV contact was made over a 56-mile (90-km) path

The Long Haul

On July 7th OZ1UM and Steen OZ9ZI made a new attempt at establishing an ATV contact from Skagen to Spodsbjerg. For a talk-back frequency, 10 GHz SSB was used. Although the OZ1UM team at Spodsbjerg had to work with an open waveguide (no dish) on their voice station, the SSB contact was made with an S-6 signal level on both ends. At approximately 20:30 local time, the ATV signal was received for the first time. At first there was considerable QSB, but at around 2100 signals became stable. At this time they changed directions and sent pictures from Skagen to Spodsbjerg to make a two-way QSO. According to Steen OZ9ZI, it was a very fascinating experience watching OZ1UM, OZ3VC OZ5DI and OZ1JLA appear on his monitor in full color with the Spodsbjerg lighthouse in the background while he was sitting on the sand dunes in Skagen nearly 129 miles (209 km) away! *TNX to Steen OZ9ZI for the above info.* 73

Photo A. (l to r): OZ5DI, OZ1JLA and OZ1UM operate the 10 GHz ATV station at Spodsbjerg

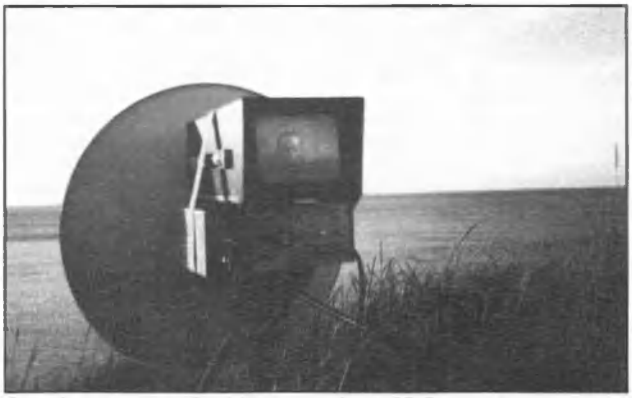


Photo B. The group at Spodsbjerg watch Steen OZ9ZI appear on their monitor over a 129-mile (209-km) path.

Photo C. The Spodsbjerg crew is shown as received in color by Steen OZ9ZI at Skagen. Photo by Steen OZ9ZI.

UPDATES

PTT Control From Receiver Audio

With regard to the above mentioned article, which appeared in the January 1995 issue of *73 Amateur Radio Today*, a correction has been pointed out by Ken NØITL. The LED in the schematic was inadvertantly shown in reverse. However, the LED is correctly shown on the FAR Circuits printed circuit board and on the PCB artwork. The schematic appears on page 32. Thanks to Ken for his sharp eyes.

Also—do not substitute small signal type diodes (914 or 4148 types) for the specified 1N4001 diodes. The small signal type diodes have considerably lower conductivity threshold voltages than the iN4001 types, and their use will cause the units to operate improperly. 73

QRP

Number 21 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

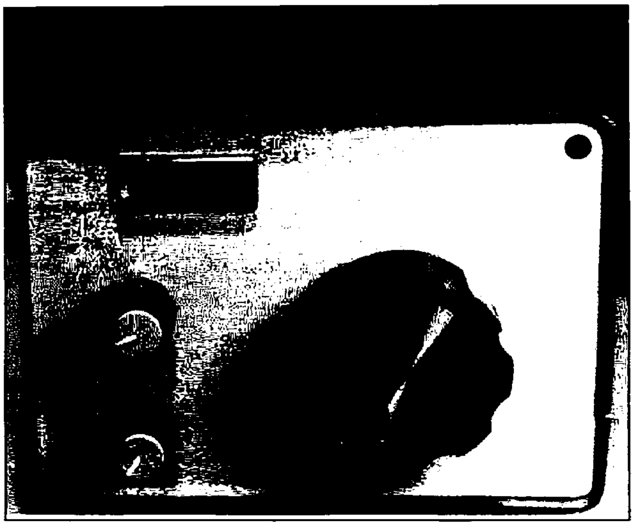


Photo A My version of Dave's superhet 40 meter transceiver The lack of dial calibration means a digital readout to be added later.

There's been plenty of new projects to keep the soldering irons burning late at night. This month, we'll look at a very popular 40 meter transceiver by Dave Benson N1NNG. This rig first appeared in *The Quarterly*, and Dave has given the nod to reprint it here. I'm not going to go to deep into the hows and whys of this rig, but rather take a look at putting it together and putting it on the air.

Originally designed for 20 meters, the rig can be modified to work on 40 and 30 meters as well. I just happen to enjoy 40 CW, so that's the band I chose.

The rig uses a superhet-designed receiver for single signal reception. It is not a direct conversion receiver. The transmitter is full QSK using electronic switching and no relays. The transmitter will produce about 1.5 to 2.0 watts output, depending on supply voltage and frequency. Transmitter control is by a variable capacitor/tuned circuit VFO instead of the varactor scheme of the NorCal transceiver.

The rig is made up of two small PC boards. One contains the receiver, while the other contains the transmitter/mixer and QSK components. The rig will drive a small speaker with enough volume to be useful in a small room. There's a sidetone that monitors your keying.

I brought the rig in kit form from Dan's Small Parts. Write to Dan for more information about this project. You can get just the PC board, the full kit, or specialized parts for the transceiver. (Dan's Small Parts, 1935 South 3rd West #1, Missoula, MT 59801.)

Dan uses a lot of surplus parts in this kit. It takes a bit longer to figure out the strange markings on some of the parts, mostly the capacitors. Some of the parts won't fit the board as they should. I tossed those guys in the junk box and used my own parts that did fit the board.

Assembly

Assembly is typical of a baggie of parts kit. I decided to build this rig in a box big enough to handle some extra goodies down the road. I have plans for a small 5-watt amplifier stage, an S-meter, and perhaps a digital readout for the VFO. The ultra-miniature stuff-it-in-a-box rage is not going to happen this time. The cabinet is steel and aluminum, with a sub-chassis for added strength. In fact, this cabinet was made by the now defunct Dentron Electronics. This cabinet used to hold a small multiband QRP rig called the Station One. It covered 80, 40 and 15 meters, used a direct conversion receiver and sported a digital readout. I had one of the few prototypes ever built and, like a dummy, sold it at a hamfest years ago.

As it worked out, I was able to use many of the holes already punched in the rear apron. These included the SO-239 chassis mount and holes for 1/4 key jack and headphones. Two smaller holes were put to use supplying power to the transceiver. In this case, five-way binding posts are used. They are not my connector of choice for power, but why drill more holes? The rear apron is 1/8" tempered aluminum. The front panel is made of .062 aluminum. The top and sub-chassis are made of cold rolled steel.

Because there's a lot of activity going on inside the chassis, several aluminum shields were installed. One is placed between the transmitter and receiver board while a second shields the 5-watt amplifier section. I plan to use some sort of digital readout, so a third shield will be added to keep noise from the digital section out of the receiver.

I added a small PC board to the rear of the transceiver to drive the S-meter. It's an audio-derived circuit from one of Doug DeMaw's books. It drives a small edgewise 200 μA meter. It's more bells and whistles than anything else, although it does make it easier to center a signal in the bandwidth of the receiver. I backlight the meter's face for that professional look, using a grain of wheat bulb. The bulb also serves as a "power on" indicator.

Since this rig uses a variable capacitor for tuning the VFO, the capacitor must be mounted very carefully. I used a small block of Teflon machined out to fit the oddly-placed front mounting holes. The variable capacitor from Dan's Small Parts has an internal vernier drive. That's one less piece of hardware that needs to be installed. If you don't have this type of capacitor, then you'll need to add some sort of drive reduction gearing. The tuning capacitor is driven directly from a single knob without a coupler or additional reducers.

A very common mistake made when working with a VFO is using a small-gauge wire between the tuning capacitor and the rest of the VFO circuit. As this wire moves around by movement of the rig, the frequency changes. In my transceiver, I use a very short, very stiff piece of copper wire. It's a hunk of number 12-gauge wire from some Romex cable. Twisting of the case does not produce any noticeable movement of the VFO. I also used a rather unusual method of sealing the VFO components to the PC board.

Stability of the VFO may be impaired by the physical movements of parts on the PC board. Normally, a

"Originally designed for 20 meters, the rig can be modified to work on 40 and 30 meters as well."

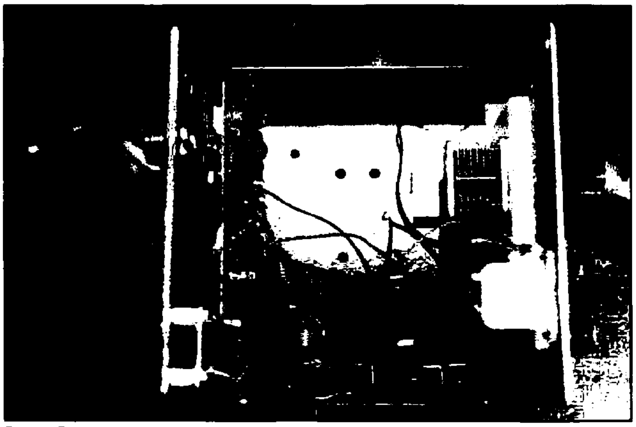


Photo B. Inside the rig. The large open area will house the 5-watt PA and the digital circuit for the display.

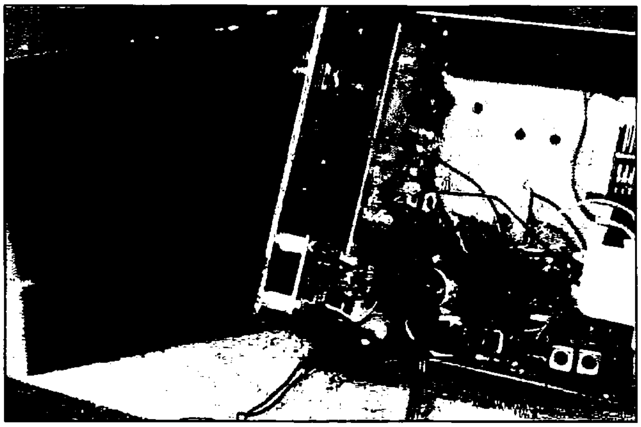


Photo C. The S-meter PC board is mounted on the rear of the rig. Notice the SO-239 antenna connector also on the rear apron.

good glob of coil dope is applied to the capacitor on the circuit board. Having long run out of that stuff. I heated up the hot glue gun and applied a glob on the parts that needed it. So far so good. The heat from the glue did not seem to hurt the parts, and they sure don't move around on the PC board!

To keep everything as secure as I could, I mounted all the PC boards with 3/8" long threaded metal standoffs. They keep the boards secure and provide ample grounding. A heavy solder tinned copper braid connects all of the circuit boards to a common ground.

Changes to the Circuit

I did do some minor changes to the basic circuit. I added a brute force RF gain control between the receiver board and the OSK circuit on the transmitter board. Dave designed the rig without an AGC, so you must ride herd on the volume control. Under very strong signals, that's not enough to keep the receiver from overloading. The RF gain control then works its magic.

After assembling the kit, I was unable to bring the receiver to life. Everything seemed to work, but I could not hear anything at all. After a few calls to Dave, some heavy-duty troubleshooting and a bit of luck, I found the trouble. In the first stage, two tuned stages in the front end, there are two 47 pF capacitors used to bring the two coils to resonance. In my kit, the capacitors supplied were 470 pF. Equally useful, but hardly interchangeable. After working on the front end, I found 68 pF worked as well as the 47 pF capacitors. Now that the front end was tuned, signals could be heard, but they weren't very loud.

This trouble was traced to a misplaced resistor between the BFO and the audio amplifier switch. The MOSFET audio switch was never turned completely on, greatly reducing the gain of the receiver. Check these two areas if your transceiver refuses to come to life. Just to be sure, I replaced the MPF-102 MOSFET with a prime component instead of a surplus device.

Audio can be enhanced with this rig by enclosing the speaker in some sort of cabinet. I used a plastic top from a spray paint can to form a seal against the back of the speaker. It's amazing how much better the audio sounds after such a simple fix. The plastic top is held in place with a couple of globs of hot melt glue. I use a two-prong plug and jack so I can disconnect the speaker from the rig if need be. When using headphones, an open circuit 1/4" jack automatically disconnects the internal speaker.

The Transmitter

I found the transmitter the least troublesome to get running. With the power supply sitting at 13 volts, the little guy will do about 2 watts into a 50-ohm load.

But, watch out—you have the two transformers used for mixing the VFO output to the transmitter's oscillator. It's very easy to get the two transformers to peak at the wrong frequency. In my case, I easily produced several watts at 8 MHz instead of 7 MHz.

Only after looking at the output with a scope and frequency counter did I see the trouble. A retuning of the two stages put the rig right on the desired output.

I never did like using homemade dials for my rigs; I plan on using the PC-1 counter from S & S Engineering to display the operating frequency. An RCA-type jack installed on the rear apron brings the output of the VFO to the counter. I plan to add the counter internal to the rig later on. By reading the VFO's frequency, I'll have a poor man's version of digital readout.

Adding an RIT is possible, but alas, I've not attempted it. If you want complete details on adding RIT to this transceiver, send me three first-class stamps and I'll send you several sheets of modifications, and of course the RIT circuit.

The RIT comes from Roy Gregeson W6EMT, who also made several changes to the basic circuit. Perhaps the most important one is changing the configuration of the 1350 IF amplifier. It's too involved to present here, but I'll include it with the RIT modification. Basically, it requires cutting several traces around the 1350 and adding some components. The result is supposed to be astounding. I did this modification early on, and found the 1350 went into oscillation at the blink of an eye. This is caused by too much gain in the IF stage. But, make a note that I did the modification before I found the trouble with the front end tuned circuits.

This is an enjoyable project, but it's not for the first-time builder. The instructions from Dan's Small Parts are very limited, but not as bad as a Kanga kit. You should have burned up several soldering iron tips before taking on this project.

When you're done, however, you'll have a real smooth operating QRP transceiver on your hands. I really enjoy making QSOs with this transceiver. I plan on working Field Day using this rig. I'll let you know how I make out.

"I plan on working Field Day using this rig. I'll let you know how I make out."

RTTY LOOP

Number 22 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

New Software

One of the frequent foci of this column is software available for the amateur desiring to run one of the digital modes—that is, RTTY, AMTOR, packet, or the like—with a computer. This may, or may not, include one of the popular multimode controllers as well.

I received an E-mail message a bit ago, which took me to task. Jim Jaffe WA2VOS wrote, in part:

"I am fairly active on RTTY (PACTOR) and have been using this mode since late 1976. When my CP-1 conked out back in 1989 I went to a PK-232, and with the Apple IIe computer suddenly found that I was out of luck with AMTOR, as there was no software out there to support the Apple and this new mode! As luck would have it, I got my hands on a PC, and someone gave me (copies of existing programs, which did not satisfy him).

"During that time a new face appeared on the Ham Horizon, namely Gary Johnson KF7XP, who is the author of XPWARES and who has written supporting software for all the TNCs on the market, including the German PTC units. So now we have a program that fully supports the ANSI color commands, contains a full-blown stand-alone log book, and support for (several brands of amateur radio directories). Not only did Gary write software and re-write it over and over again to rid it of those nasty critters we call bugs, but he also maintains a BBS and an FTP site on the Internet so that I can download all the latest wares for distribution as well as our overseas fellow hams who have Internet access as well. Gary responds to mail, requests complaints, critiques and sometimes instantaneously re-writes software to accommodate our needs. I have made well over 4,800 contacts using my PK-232 since 1990, when I began keeping the electronic log. As far as I know, Gary's software is the only one that offers a log conversion program that successfully converts any electronic log book to his logging format. His program operates in the Host mode, which (others) do not."

Somewhat stung, I surfed onto the Internet, using my handy-dandy AOL interface, and dropped Gary a note. His response was:

"I have no problem at all with you reviewing the software or adding it to the disk collection. There are several programs on the FTP site for the KAM, AEA and PTC type controllers. All programs have the same basic features, just optimized for the different controllers. There is also an external logging program that interfaces to the software. It is called XPLOG. Several of the menu options in the MISC menu are tied to the external logger. 73, Gary KF7XP"

Now that I have whetted your appetite, let me tell you about these programs. As Gary said, there are several "flavors" of XPCOM. They all include, though, the following features:

- Pull-down menus.
- Custom operation with the AEA PK-232, KAM, MFJ-1278 and PTC.
- Mouse compatibility.
- One-key brag file and text operation.
- External interfacing to the user's favorite text editor.
- Offers full PACKET, AMTOR, FEC, PACTOR, BAUDOT, GTOR, TOR, GTOR Monitor and CW modes. (TOR, GMON and GTOR in XPKAM only.)
- Full use of the HOST mode for the AEA PK-232 and KAM. Pseudo-Host Mode operation for PTC controllers.
- Simplified command structure for the MFJ-1278.
- Intuitive on-line help system.
- Quick-Connect feature for packet.
- Real time and background printer support.
- Built-in logging, with auto search.
- Macro support. TYPEOVER Macros, allows you to insert text macros into ANSI files without destroying the picture.
- Multi-Window ANSI color support for GTOR, PACTOR, packet and ASCII. (VT100 emulation.)
- Radio Interface for most transceivers that support computer control.
- Direct Buckmaster, SAMS and QRZ! *Callbook* Interface.

Now, as to the varieties. XPCOM Version 1.55 supports AEA (Host Mode) and MFJ-1278 controllers, including dual TNC Support. XPDUAL supports AEA (Host Mode) PK-900 and DSP 2232 controllers. XPKAM supports Kantronics KAM and KAM+, including GTOR and PACTOR, and built-in GTOR Monitoring without the need for external programs! The AEA and Kantronics versions also support multi-connect operation with XP Windows, and multiple ASCII file transfer in packet mode. And, finally, XPPTC is available for the Paccomm PTC and SCS PACTOR controllers.

Each of these programs is supplied separately, as shareware, with a $39 registration.

As Jim and Gary indicated, there is also an external logging program, XPLOG. Briefly, this is a versatile logging program that can operate as a stand-alone program or from XPCOM, including name/QTH browsing, antenna heading assistance, and more. Together, this is one complete package.

Just to put any other questions to rest, these programs should run on almost any PC-compatible system, requiring any of the 8088/86/286/386/486 series. 512K memory (640K recommended), a monochrome, CGA, EGA, or VGA display, and an optional Microsoft-compatible mouse. Multimode controllers supported include the AEA PK-232 or MFJ-1278 for XPCOM, the AEA PK-900 or DSP-2232 for XPDUAL, the Kantronics KAM or KAM-plus version 6.0 or later firmware for XPKAM, and SCS or Paccomm PTC controller with version 2.00 or later firmware for XPPTC.

There are at least two ways to obtain this software, presuming you do not have a buddy with the disk, or have the material on a local BBS. You can log onto Internet, at ftp. Indirect.com, under the /pub/software/hamradio/xpware directory, and download the material directly. Alternately, you can send for the latest additions to the "RTTY Loop" Disk Collection, disks 9, 10, and 11, which contain all the programs and documentation discussed above.

Composition Software Question

Just to change the subject, how about a question to you all? This from Richard, WA1SKQ, who writes, via AOL:

"Just a quick question, perhaps you can help steer me in the correct direction. I've been running PACTOR for quite some time, and during the past year, I have been using a PK-900 running off a 486DX and PcPakratt for WINDOWS. All nice stuff, and no complaints. With the 900 and other TNCs coming on line, more and more folks are transmitting graphics . . . great stuff to copy, but a bear to create. I'm finding plenty of ANSI files on a variety of on-line services, many on AOL, but have more interest in composing my own. A ham friend sent me a program called THEDRAW. He had billed it as capable, but not user friendly, and I'm forced to agree. Though I can generate some interesting color graphics for use in AMTOR, it's a real chore. Is this the way of ANSI graphics, or is there some software out there that makes composition a bit less of a chore? Thanks for your help, and keep up the good work."

Well, Richard, I was going to suggest THEDRAW myself, as I started to read your letter. I use that program to create ASCII/ANSI screens for my medical software. I will leave it open to the readers, though, to suggest more "user-friendly" software. I just happen to like THEDRAW.

For those who may have come in late, any or all of the disks in the "RTTY Loop" Software Collection remain available. To obtain a list of programs, just drop me a self-addressed stamped envelope to the address at the top of this column, or send E-mail to one of the addresses below, and I'll send along the list forthwith. Each disk in the series can be yours by sending a 3.5" high density disk, $2 in US funds per disk, and a self-addressed mailer with sufficient postage to me, along with a note telling me which collection you would like.

Of course, I always welcome comments or questions. Those vital E-mail addresses are: CompuServe 75036,2501; Delphi MarcWA3AJR; America Online MarcWA3AJR; Internet MarcWA3AJR@aol.com. Such a comment turned me onto the software highlighted this month. Who knows where your question will send me? I look forward to it, just as you look forward to next month's "RTTY Loop"!

Ask Kaboom

Number 23 on your Feedback card

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Mail Call!

I have just returned from a trip to China, Hong Kong and Hawaii. I didn't get to do any hamming in China, and, as far as I could tell, the whole subject was one not very familiar to the average Chinese. (Then again, the average American these days is in pretty much the same boat.) In Hong Kong, I visited uncountable numbers of electronics shops—there are at least two on every street in Kowloon. It's Kaboom heaven. They're very much like the ones in New York, though, in that they make the prices up, and I do mean up. These, however, expect you to bargain. Many prices were much higher than here in the States, but some were lower. The most interesting aspect of those stores was that just about every one of them had ham gear in the window! I saw lots of Icom HTs, many Standards and a few Kenwoods. No Yaesu stuff at all. I even saw a few Icom HF rigs, along with antenna tuners and high-current DC power supplies. Can ham radio be that big over there? I don't think so. In fact, I never saw any mention that this equipment was for amateur radio. The HTs were billed as VHF and UHF, usually with no description of frequency. Most of the VHF sets were on 2 meters, but some were not, and I have no idea what frequencies the UHF gear was on. There were signs in several ships warning that use of the radios was illegal in Hong Kong, which suggested to me that, once the buyer left the area, he was pretty much on his own. In other words, I think people in Asia buy these things and just use them, without benefit of license.

Before you go salivating over the idea of getting great deals on HTs via mail-order, I must tell you that the prices were higher than they are here. Oh well. By the way, that cute little Standard 2 meter HT that runs on two AA cells was available in UHF over there, so I wouldn't be surprised to see a 440 version here one of these days.

I had the use of a dualbander HT in Hawaii, and I tried to use it to say a few alohas to the local hams. I met with little success. I heard QSOs, and I put out a number of "listenings," but I managed to engage in only one conversation, and that one was a round table which never got back around to me. I was bringing up repeaters just fine, but it seemed that nobody wanted to talk. I don't want to go and impugn Hawaiian hams, though, so I'll just assume my signal wasn't strong enough or something. Hawaii was one of the most beautiful places I've ever seen, and the people I met were extremely friendly, so I hope to go back and try some more hamming one of these days. I'll let you know more when I get there!

Piling Up

While I was away, some mail started piling up, so I thought I'd take this opportunity to answer a few letters. Here goes:

Dear Kaboom,

Recently, my Kenwood TS-450S has developed an RF-like hum during CW transmit. All my antennas and ground system seem fine. The only remaining suspect components are my Astron RS-35M power supply and the transceiver itself. The radio appears to be operating fine on receive, and tune-up into the dummy load appears normal except for the appearance of the hum and a slight oscillation which shows up on the digital metering. Prior to this problem, the power supply had gone into crowbar protection mode before resetting after shutdown and restart. Any ideas?

Signed,
Hummin' the AC Tune

Dear Hummin',

I think you hit the nail on the head with your last clue. Why did the supply go into crowbar protection? The usual reason is too much voltage at the output. It sounds very much like you have a shorted regulator transistor in the power supply. Measure the voltage while the rig is in receive: your rig should be drawing about one amp, which should keep the power supply in proper regulation. If your measurement exceeds the supply's ratings by much, and I suspect it will, there's your answer. Also, if you have a scope, check the DC line with the scope set to AC coupling and the sensitivity high. If you have more than the rated 60-Hz ripple, that's another clue your regulator is gone.

Dear Kaboom,

I have noticed that both of my HF rigs, which come from different manufacturers, throw a large RF pulse out the antenna jack on initial keydown. I can see it on meters and on my oscilloscope. My concern is how it may affect my Ameritron AL-80B amplifier and other equipment. The amp's manual expressly describes this phenomenon, and warns not to underload the amp to reduce power, as this could cause extremely high energy levels in the plate and grid circuits.

This worries me, as it causes output pulses measurable at over 1.5 kW PEP, and the amp is only rated at 1 kW. The pulse remains even if I have the amp set at much less than maximum rated output power, forcing momentary illegal operation. Plus, it exceeds some of my equipment's power ratings. Is there any solution to this mess?

Signed,
Zap

Dear Zap,

This is a tough one. The RF final amp stages in HF rigs use negative feedback to control themselves. They're just like the ALC loops used with external amps, only these are internal to the radios. In order for them to control anything, the negative feedback loops must have something to control! In other words, the output must go high enough to let the ALC build up its voltage and squeeze it back down. In the audio world, the time lag between cause and effect results in something called TIM, or transient intermodulation distortion. In effect, it's just what you're describing: a huge overshoot before the circuit acts. For that reason, most high-grade audio gear uses little or no negative feedback. Unfortunately, there's no easy way out of this problem in the RF world. Most hams probably just ignore it but, you're right, it does lead to quick bits of excessive and illegal power. All the amp manufacturer seems to be saying is to let it happen, because trying to prevent it by underloading the amp will cause all that input power to damage the amp's grid circuits. I seriously doubt that the momentary pulses will damage anything else, simply because they're so short. But they are technically illegal, and I applaud you for caring. Still, I have no answer for how to prevent it, except perhaps to use an attenuator between the radio and the amp. Naturally, you'll need a big one that can handle your rigs' output power, and it sure will limit your total output. It's an ugly solution at best. If any reader has a real solution, please let me know and I'll be glad to send it along. By the way, I've seen this problem too, and it once caused some trouble for me. I never did solve it.

Dear Kaboom,

I'm an electronics experimenter who frequently uses "junk box" parts. In December's column, you started describing the Japanese format for marking capacitors. I have lots of caps with such markings, and I need to convert the values into the American format so I can use them. Could you please explain the system?

Signed,
Perplexed

Dear Perplexed,

Sure. Essentially, all Japanese capacitors are marked in picofarads, which is 10 to the -12 power. The first two numbers are the value, and the last is a multiplier, kind of similar to the system used with resistor color codes. For instance, a cap marked 102 is 10 with two zeros, or 1000 pF. Now, 1000 pF is the same as .001 µF, because 1000 X 10 to the -12 equals .001 x 10 to the -6. If all that calculation is too annoying, just remember it this way: 105 is 1 µF, 104 is .1 µF, 103 is .01 µF, 102 is .001 µF, and so on. So, a 152 would be .0015 µF. And, a 473 would be .047 µF. If you make a little chart, you'll never have trouble with this.

Well, I think that about does it for this month. Next time we'll get into a new topic and answer a few more letters. Until then, 73 and aloha de KB1UM. I sure do miss those papayas!

Number 24 on your Feedback card

HAMS WITH CLASS

W2KGY

WEST POINT

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

A Salute to West Point

This past summer I was invited by Captain Curtis Carver to speak to potential members of the West Point Amateur Radio Club, W2KGY. I am familiar with the incredible scenery in Orange County, New York, and welcomed a chance to visit that region again.

A visitor cannot help being impressed with the breathtaking views of the Hudson River, especially as seen from a ham's vantage point—the roof of Bartlett Hall. The grounds of the United States Military Academy at West Point are truly beautiful. It is an open base to visitors, and had over three million guests last year. West Point is Orange County's primary tourist attraction. In fact, it is New York State's third most popular attraction, ranked behind New York City and Niagara Falls.

Captain Carver is N2XJF and he is the OIC (officer in charge). It was with great pride that he escorted me on a tour of the facility. He explained that CARC (Cadet Amateur Radio Club) was founded in 1928 and is sponsored by the Department of Electrical Engineering and Computer Science. It receives administrative support from that department.

Photo B. Captain Curtis Carver N2XJF with Carole Perry WB2MGP in front of Bartlett Hall.

The club station is currently outfitted with the latest communications equipment. These include:

- Yaesu FT-736 satellite earth station
- Icom IC-781 all-band shortwave transceiver
- Kenwood TS-440S All band shortwave transceiver
- Icom IC-290 all-mode 2M transceiver

The station has two computer systems, including a system being installed to provide a 24-hour mail processing and forwarding node and BBS.

The club station currently has equipment to operate HF and VHF, SSB, FM and CW, as well as digital modes such as RTTY and packet. The club has a satellite station for the VHF/UHF bands, and high-power amplifiers for the HF bands, making worldwide communications possible nearly any time.

The annual operating budget and funds for new equipment are provided by the Directorate of Cadet Activities. These funds are the result of the generous donations of former graduates through the Association of Graduates.

I thoroughly enjoyed my visit to the Point and to the amateur radio club. There were approximately 15 cadets in attendance for my presentation. There are many clubs and activities competing for the time of these hard-working cadets. My impression was that the young men who came to the meeting were genuinely interested in pursuing the hobby. Captain Carver promised to keep me posted as the cadets got licensed.

On a follow-up visit to West Point in the fall, the president of CARC, Scott Kirkland, escorted a fellow teacher from my school and myself on a tour of the areas I had missed before. We were especially interested in seeing how the classrooms were set up. Teaching on an intermediate school level, my colleague and I enjoyed hearing about the teaching methods and curriculum aids used with these highly motivated cadets. It was a fascinating and informative experience.

The children in my amateur radio classes are looking forward to setting up skeds with CARC. That should be fun for everyone!

Photo A. QSL card from West Point Amateur Radio Club.

Photo C. CARC (the Cadet Amateur Radio Club).

For more information about the amateur radio station at West Point, contact the Department of Electrical Engineering and Computer Sciences, United States Military Academy, West Point, NY 10996, or call (914) 938-2200.

NEVER SAY DIE

Continued from page 4

he's able to fire it up and get heat every time. A whole lot of heat. Thousands of times more heat than is available via any chemical reaction known to man or scientists.

Screw E-Mail

So, while I'm not having to sit here reading endless E-mail, I'll spend my time trying to manage my businesses, reading a ton of books, talking with people brighter than me on the phone, writing wise-apple editorials, and generally trying to entertain you and get you thinking. What do you know about fermions, baryons, muons, gluons, pions, sub-quarks, tachions, bosons, leptons, and so on?

And if I were to be available via E-mail, what kind of stuff would you send me? Why not use fax? That way, when you run across a newspaper clipping or obscure magazine article you think I ought to see, you could send it to me immediately. Oh, if you do fax, none of those damned cover sheets, understand. My secret fax number is 603-588-3205. Please don't tell anyone.

The ARRL Fought RTTY

Why did the ARRL fight so hard and long to keep RTTY off the low bands? There were two basic reasons. The most important one was that the League's name was the American Radio Relay League. That stemmed from the first ham communications via spark, when radio signals wouldn't go very far. Thus, in order to cover any distance, operators had to relay messages. And so when the club started, it was a message relaying club.

When CW was developed this continued with the development of their national traffic handling net organization, the Brass Pounders League, and so on. For many years thousands of hams originated unimportant messages and relayed them all around the country via the traffic nets, imitating Western Union and Postal Telegraph. Only slower and with far more errors. Well, it was something for hams to do with their spare time. And it was fun.

So when RTTY came along around 1948 it was seen as a serious danger by the League. Imagine, a network of RTTYers relaying messages at 60 wpm with no errors, and all done automatically. I set up a RTTY station in a VIM store on 42nd Street in New York and relayed thousands of messages from the general public for Christmas in 1952 to our servicemen overseas. Check your back issues of *CQ* for a picture of me on the January 1953 cover (with hair) with Bill Halligan of Hallicrafters, Faye Emerson, and her husband Skitch Henderson. While you're digging through your magazine museum you might enjoy reading my old RTTY columns in *CQ*.

By the way, I ran so much traffic through my RTTY station that I made the ARRL's BPL for that month. I kept everyone busy sending thousands of Christmas messages to our overseas servicemen all around the world.

The ARRL also automatically fought every rule change proposed to the FCC that they didn't originate. This was their way of trying to maintain total control of the hobby. Fortunately they seldom won these fights.

When I became the *CQ* editor in January 1955 I visited the FCC and found that everyone in the amateur radio division really hated the League and their arrogant legal counsel, Paul Segal, who was not even a ham.

The ARRL eventually lost their fight to prevent RTTY on the lower bands and activity started growing rapidly. When I started my RTTY column in 1951 there were only about 200 active teletype hams. Somehow I seem to get involved in these new technologies early on.

I started pushing repeaters when there were only a hundred or so in use. Now there are around 8,000 or so, just in the US, plus some spillover into the commercial market with cellular telephones. And I started *Byte* just five months after the first microcomputer was put on the market by MITS. The first CDs came to the US in 1982 so I started *Digital Audio* in 1983. I started *"Cold Fusion"* last year, while the technology was still in the test tube. Well, it's still in the lab, but it'll be breaking out soon.

Ham Radio Broadcasting

With more and more amateurs getting het up over Baxter's seemingly endless ego-gratification broadcasting on the ham bands, perhaps it's time to look back over the history of this aspect of our beloved hobby. It's coming on to 60 years that I've been involved with hamming, so as probably the oldest living editorial-writing ham, maybe I can put this mess into perspective. This is not a pretty story, so fasten your seat belt.

When I first got involved with amateur radio we had one main ham broadcasting station: W1AW. They were on daily with bulletins and code practice transmissions. The transmissions were all automatic, so the bottom line was that the ARRL had their own private frequency in each of the ham bands. If you happened to be making a contact on their frequency when schedule time arrived, you were crunched.

What few amateurs knew was that the ARRL was using paid operators for W1AW, even though this was completely illegal according to the FCC rules. The FCC was well aware of this, but turned a blind eye.

The last time I visited ARRL HQ they had a gorgeous line of commercial transmitters, with everything computerized so that the operator could sit there and just watch the bulletins being broadcast on all bands completely automatically.

Though I've been an ARRL member for nearly 60 years, I haven't listened to a W1AW broadcast since the 1930s, so I have no idea of what frequencies and times they are broadcasting. I think the last time I heard W1AW was when they were chasing us off 160m on December 7th 1941. I was on the air the day we were shut down, and back on the day 2-1/2 meters was opened in 1945.

In the 1930s there was no restriction against ham broadcasting, so every now and then, mostly on 160m, some ham would get on and play records for a few hours. This eventually ticked off the FCC monitors, with the result that the Commission passed a rule prohibiting us from transmitting except for the purposes of two-way communications. I think that was dumped on us in January 1939, as I recall.

Naturally, as with virtually every new FCC regulation, there were unintended ramifications. The FCC monitors interpreted this new rule as also prohibiting us from relaying other ham stations. Until that time networks of four to eight low-powered stations would get together on 160m, with half the stations on the high end of the band and the other half on the low end, all transmitting and receiving at the same time, making it so four to eight of us could just sit there and talk as if we were in a room together. Duplex operation. Those who remember those days will tell you how much fun it was. If you run into Wall WA6BMG, who used to be W2LBF, right around the corner from me in Brooklyn, ask about it.

So here we are 60 years later, still making stupid one-way transmissions. That's crazy. Sure the telephone started out that way, but they quickly invented duplex—so why haven't we? Not that it's very difficult. There are any number of ways we could do it, several of which I've discussed in past editorials. Nothing has happened. To which I say phooey.

Thirty years ago I set up one whale of a ham station high up on Mt. Monadnock. It was a corker! I had big rigs on the VHF bands, with a kilowatt AM rig on 2m and a 336-element beam which poked an S-7 signal down into North Carolina under even the worst propagation conditions. It was set up by the *73* crew and they did most of the operating in their personal time. No one was paid to operate, and we made no bulletin broadcasts or anything like that. It was just for fun.

The next thing I knew the labor board was all over me, claiming that the station could not legally be operated by any employees unless they were paid at least the minimum wage. I pointed out that this was completely illegal according to the FCC regulations. They pointed to W1AW. That was the first time I knew that the W1AW operators were being illegally paid. That's when one of the labor board people mentioned that the original complaint had come from the ARRL. Well, this was at the time when I'd started the Institute of Amateur Radio, which had the League very concerned. They seemed willing to spend whatever it took to put the IoAR out of business. Ask any old-timer about WARN, the Washington Amateur Radio News, which I was told was funded by the ARRL, and which seemed completely dedicated to attacking the IoAR.

The main purpose of the Institute was to provide legal funds to help amateurs fighting lawsuits which could affect us all. It was never intended to supplant any service the ARRL was providing. The IoAR did indeed fund several such suits and helped win some major ones. The hams involved were amazed when they discovered that the ARRL would not help cover their legal expenses when fighting lower and other such important cases.

The secondary aim of the Institute was to keep Congress aware of the services amateur radio was providing. This, again, was not being done by the ARRL. I had no interest in duplicating anything the League was doing, but the mere existence of the Institute was viewed by the ARRL as a danger which had to be eliminated.

I probably would have continued the IoAR had it not been for my first divorce. That really did a job on me emotionally. Yes, of course I should have known better, but when love comes in, reason flies out the window. So I found myself married to a very disturbed woman and spending tens of thousands of dollars on psychiatrists. This culminated when she threatened suicide and her doctor ordered me to put her in the state mental asylum.

I'd been publishing a VHF magazine (*6up*), a contest magazine (*5-7-9*), and a club newsletter editor's magazine monthly, printing them myself on a press which was set up in my garage. I was also putting together kits of parts to help the readers build our construction projects. So when the divorce hit, complete with the loss of my 1-1/2-year-old daughter Tully, I lost my steam. I folded the three small magazines, tried several times to hire hams to run the parts business, and turned the running of the Institute over to one of the directors. The new Institute secretary quietly cleaned out the sizable treasury I'd sent him, and that was the end of the Institute.

I started traveling to get my spirits up. In 1965 I visited hams in the Caribbean and went diving around the British Virgins and at Curacao. I made a trip to Sweden, Åland, Finland, Yugoslavia, Hungary, and Geneva. In 1966, with two other hams, I went on an African hunting safari, and then on around the world, getting on the air from all kinds of rare spots. Like Nepal, New Caledonia, Tahiti, Fiji, Kenya, Damascus, Afghanistan, Iran, and so on. When I got back, reinvigorated, and ready to move ahead, I found that the hams I'd left to run the magazine three months earlier had almost killed it. It was in a real mess.

It didn't help that the entire ham industry had collapsed in 1964 and 1965 as a result of the ARRL's so-called "Incentive Licensing" proposal to the FCC. That's the one that put 85% of the ham stores out of business in one year, 90% of the ham manufacturers, and closed down around 90% of the ham clubs.

The chap I'd left as the assistant publisher and editor had rifled our cash and done everything he could to put us out of business so he could help start *Ham Radio*. I'll tell you about that some time.

Baxter

So here we are in 1995 and we have two major ham broadcasting stations, W1AW and K1MAN. I've never listened to K1MAN, so all I've heard are tapes sent to me by angry hams who wish Baxter would stop what they perceive as his virtually endless ego-puffing baloney which ties up about 10

kHz of several ham bands for hours a day.

The more serious downside of this is that the irritated hams are turning in frustration to the FCC and even to Congress to try and stop what they see as an egomaniac from his endless self-promotion on our ham bands. I hope this won't burst any bubbles of optimism in your mind if I point out that the FCC Commissioners don't know beans about amateur radio, and don't care. Thus, if we make ourselves a nuisance over Baxter we could easily trigger the normal government response to problems: get rid of the complainers. Shoot the messenger.

Unfortunately we have no bullet-proof vest for amateur radio. Even a casual look at our regulations will tell you that the basis and purpose of amateur radio is pathetically out of date. We are permitted to keep our billions and billions of dollars of ham bands just because we've always had 'em and the FCC has never had an occasion to rethink why we exist.

I'm getting more and more letters from readers who are pointing out that QSOs via the Internet provide inexpensive interference-free solid contacts anywhere in the world. These contacts make amateur radio look like we are still using smoke signals. These contacts are generating international friendships faster than the ARRL's DXCC is destroying them by forcing hams in rare countries off the air to avoid the hordes of QSL hunters.

Yes, we're still of use in some emergencies, but cellular telephones are rapidly putting us out of business in this area too. I've tried for years to get hams to develop high-speed message handling systems for use in emergencies, but many of the ARRL traffic nets are still poking along at 10 wpm or so, and messing up messages. Modern communications technology can throughput more words in a few hours than every amateur who has lived has transmitted in the last 80 years. But that's not good old-fashioned CW technology.

We are of no further use in time of war either as operators or technicians. Modern equipment is modular, so all anyone has to do is plug in replacement modules until the equipment works again. Most technicians today don't have to have a clue how anything works. Engineers? We're turning out a record low of them from our colleges. Indeed, over 50% of the graduating engineers from our colleges are foreign students.

One of the last things we want to do is irritate the FCC or Congress. So what can we do about some of the crazies we've let into amateur radio? Obviously the code test has totally failed us as a filter for crazies. Indeed, most of our more serious problems seem to be caused by Extra Class hams.

Okay, if we can't turn to the FCC or Congress to get hams like Baxter out of our hair, what can we do? How can we handle situations like this ourselves?

One group has semi-organized to fight fire with fire. They transmit on K1MAN's frequency (3975) on 75m for hours at a time on Sunday evenings, doing interviews with such Baxter unfans as Bill Pasternak and Hap Holly. I recently participated via phone patch and WO4TA for a two-hour stint. We had call-ins with comments and questions from as far as Boulder (CO). I could get addicted to that. It almost got me to thinking about putting up a tower, hanging a couple 75m dipoles from it, and dusting off my Henry 2K. That's the setup which used to put an S9 signal into Australia on 75m.

I've been thinking in terms of producing some 90-minute tapes to sell at hamfests where I haven't been invited to talk, and to see what I can turn out in the way of a syndicated broadcast band talk show, with me reviewing interesting books I've read, some of the better new CDs, and discussing proposed solutions for our social problems. Oh, I'll be pushing kids to get involved in ham radio too. That's one part of my proposed solution to our lousy school system.

While I was in Florida recently doing a report on the first patented cold fusion device, I came across a small audio mixer and cassette recorder. It was just what I've been looking for, so I snapped it up and brought it home. What would happen if I made tapes of things of particular interest to hams and sent them to maybe 20 participating hams with good solid kilowatt signals for regular broadcasts? Baxter is on 14.275, so we could take over 14.285 on 20m and 3985 on 75m.

And then the next chap with an itch for self-promotion could get a group of big signal hams to broadcast his stuff on 14.295, etc. I'll bet we could run ham bulletin nets all the way up to 14.315, perhaps wiping out the sludge on 313. We might even keep on going to 14.345!

Of course this would set up a desperate need for ham information to keep all these ham info broadcast nets going. I'll probably have to organize an information system which would deliver via the Internet.

We can even send music over these ham broadcast networks now. Digital audio is just data, and perfectly legal to transmit. Only when you get it you have to feed the data into a compact disc player instead of a computer, though most of the new computers have this fuction built in, making it easier. We can also send pictures and graphics via either slow-scan, fax, or some other protocol.

So, what do you think? Should we get upset over Baxter taking over 10 kHz on our bands for his gratification? Do any of you tune in and listen to him every day? Is he providing a valuable service? Is it more valuable than using his channel for regular contacts? And what do you think of Baxter sending notices to hams refusing to get off *his* channel a notice of felony? What do you think of the FCC fining him thousands of dollars and him refusing to pay?

Shall I start making tapes?

Work Ethic

Every time I read about the vaunted American work ethic I give an annoyed grunt. I've seen it at full

strength all my life.

For instance, back during the early part of WWII while I was going to college I spent the summer working for G.E. in Schenectady (NY) testing transmitters for the Army. The old BC-191 and BC-375 kluges. That was my first job and it was my introduction to the American work ethic. And mind you, the whole country was fired up to produce for the war effort.

What I found was a bunch of people who were proud of thinking of better ways to waste time and do as little as possible. The Army called it "gold bricking," but the "workers" at G.E. felt they were beating the company when they figured a better way to put in their time without doing anything.

They really hated me. The people on the assembly line put the radios together and then a half dozen of us technicians would test them to make sure they were within specs, then we'd calibrate them. The other techs were taking their own sweet time, turning out four or five rigs a day. I worked up a head of steam and turned out a dozen or so a day. I had a contest with myself to see how many I could do.

The other techs got so angry with me actually working that they sabotaged some of the rigs I'd calibrated and then complained to the supervisor. Oh, oh, I was in trouble when they weren't calibrated right. I look a closer look and saw where the dials had been changed from my settings. I showed the supervisor where, when they were set, I'd marked them with red glyptol, indicating that the rig was in perfect calibration. Other than being threatened with arm breaking if I didn't slow down, I had no more problems.

Shortly after that I decided to join the Navy. There I found that, like the Army, gold bricking was a matter of pride in the Navy. Only those too dumb to get out of working had to work. I never subscribed to that philosophy. I picked the kind of work I wanted to do and loved doing it. I kept the radios, sonars, and radars on my submarine in top shape. While we were on war patrols I designed and built circuits to improve my equipment.

So here we are with a work ethic that isn't what we brag about. Employees in big companies, government, and the military are busy seeing how little they can do and get paid well for. They think people who actually have to work are dumb. These people generally do not make good employees for smaller companies, where individual productivity is important.

Management

While I'm trashing big companies and the military, let me also include management. When you are in a management position in a big company you have to be very careful and not make waves if you hope to be promoted. The same goes for government and the military.

If you have creative ideas, these will make waves and you will be frozen in your job or fired. Ideas come from troublemakers. You get to the top by never being controversial, and that means never expressing an idea. The result is that big businesses, government bureaucracies, and the military are being run by the survivors of this weeding-out process. This is why we so seldom see any intelligent admirals or generals, and why so many heads of big businesses are so dumb. Just look at how stupid GM chairman Smith was when faced with Perot.

Yes, there are some exceptions. But not many. I've met too many bigwigs and found very little hiding under their wigs. I'll tell you some time about when the president of Texas Instrument refused to listen to me and cost his company at least $50 billion dollars. I tried to get An Wang to recognize the changes microcomputers were going to make so his company could come out a winner. He said I was wrong. As did the president of Data General. And the president of Centronics, then the largest maker of computer printers in the world. Now the building is being used to make pancake turners.

The chairman of Tandy refused to listen, so I put my advice in my editorial, just to be on record. Sure enough, if he'd made the change I suggested, I believe Radio Shack would have made billions more in sales and would have been able to hold their 40% share of the market instead of dropping off the charts.

It wasn't that I was any genius, it's that I knew where the computer market was heading and these captains of industry didn't. I'd done my homework and they hadn't.

The Genius

Yes, I admit to being a genius. I'm sure someone will stab me with that admission by taking it out of context. If you remember, Edison said that genius was 99% perspiration and 1% inspiration. Or was it 90-10? Anyway, I'm the perspiration type of genius. I find that the more I read, talk with people, and so on, the more I tend to know. Pretty soon I know more than 90% of the people in that field. I usually stop at around 90% and make do because the next 9% can take a lifetime. I just like to know more than almost anyone else. That's fine.

Genius has little to do with brains or IQ. As one of the founders of American Mensa back in 1960, I've met thousands of Mensans. High IQs, yes. Successful in life or in business? Seldom. For the most part they are a bunch of snobby losers. Many of the early members were much more interesting, but they got fed up and dropped out. Success doesn't take much brain power. It doesn't even take much education. What it takes is persistence. So I read and read. I do my best to meet interesting people and talk with them. That's one reason I'm having so much fun in the cold fusion field, where I've found creative people who are fascinating to know.

Do you think it's time yet to fix our school system so it teaches the old-fashioned work ethic?

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

MAY 6

CLEVELAND, OH Nat'l Expo's Electronics Fair (Hamfest/Computer Show/Flea Market) will be held 9 AM-3 PM at Emidio & Sons Center, 48 E. Bath Rd. & Old Rt. 8, State Rd., Cuyahoga Falls/Akron OH. Setup at 7 AM. Contact *Nat'l Expo, Inc., 30799 Pinetree Rd., Cleveland OH 44124. Tel. (216) 442-1776,* or *(216) 292-7744.* Reservation deadline is Apr. 25th. Please send an SASE w/payment. You may also pay by credit card; FAX info to *(216) 442-1776;* or *(216) 292-7746.*

ETOBICOKE, ONT. CANADA The Skywide ARC will host their annual Spring Hamfest/Flea Market 9 AM-1:30 PM at the Westway United Church, 8 Templar Dr. Vendor set-up 8 AM. Talk-in on 146.985 Rptr., Direct: 146.52. Contact *Gary Westhouse VE3NIT, (416) 233-2669;* or *Maury Scott VE3TEY, (416) 231-1816.*

MAY 6-7

AMARILLO, TX The Panhandle ARC will hold their Golden Spread Hamfest at the campus of T.S.T.C., just east of the airport, between I-40 and Hwy. 60. Talk-in on 146.940/.660. VE Exams Sat. Contact *Jerold R. Mc Cown, P.A.R.C. VP, P.O. Box 614, White Deer TX 79097-0614.*

MAY 7

LISBON, OH The Triangle ARC Hamfest will be held at Columbiana County Fairgrounds, 8 AM-3 PM. Talk-in on 146.70/.805 and 224.66. Contact *Dick Sisley K8JKB, 1218 Northside Ave., East Liverpool OH 43920-1642. Tel. (216) 385-1245; Packet: Rodney N8WML @ KB8JNM#EOH.OH.USA.NA.*

MAY 13

MANITOWOC, WI The Lakeshore Hamfest, Electronics & Computer Swapfest will be held at Manitowoc County Expo. Doors open at 8 AM. Setup Fri. night, May 12th till 10 PM., or early Sat. morning. VE Exams. Contact *Glen, (414) 684-7096, anytime;* or *Red, (414) 684-9097 days.* Talk-in on 146.61(-) or 147.03(+). VE Exams for all classes at Silver Lake College (Hwy 151). Test registration closes at 9 AM. Please make checks payable to Mancorad Radio Club and send w/SASE to *P.O Box 204, Manitowoc WI 54221-0204.*

SPRINGHILL, LA The North LA/South AR Hamfest will be held at the Civic Center, North Main St., 8 AM-2 PM. VE Exams. Swap Tables. Talk-in on 147.165 and 146.730. For info and reservations, write *N5NSX, 605 5th NE, Springhill LA 71075. Tel. (318) 539-4167.*

MAY 14

HAGERSTOWN, MD The Antietam Radio Assn. will present "The 1995 Great Hagerstown Hamfest" at Hagerstown Jr. College Athletic and Rec. Center, 8:30 AM-3 PM. Tailgate Spaces available on a first come-first served basis. For Flea Market spaces and info, call *Fred Bailey N3HTN, (301) 416-8079:* or *(301) 714-0688.* VE Exams by the Mountain ARC VEC. Pre-reg. appreciated. For Exam info, call *(304) 289-3576.*

LAUREL, IA The C.I.R.A.S. will hold a Hamfest at Marshalltown Comm. College (on Hwy 14), 8 AM-4 PM. Reg. for VE Exams 10 AM-Noon; testing starts at 11 AM. Contact *C.I.R.A.S., P.O. Box 184, Laurel IA 50141.*

MEDINA, OH The Medina County Comm. Center, 735 Lafayette Rd., is the location for the "Medina County Hamfest '95." The Medina 2 Meter Group, Inc. will sponsor this event 8 AM-1 PM. Ham, Computer, and Electronic Equip. Mobile Check-in on 147.63/.03 K8TV/R. Contact *Medina Hamfest Committee, P.O. Box 452, Medina OH 44258. Tel. (216) 725-4492, 10 AM-5 PM.*

WHEELING, WV The 18th annual Wheeling Hamfest/Computer Show will be held at Wheeling Pk., Rte 40. Setup at 6 AM. General admission 8 AM-3 PM. Flea Market. Contests. Banquet. World's largest telegraph key. Contact *TSRAC, Box 240 RR 1, Adena OH 43901. Tel./FAX (614) 546-3930.*

MAY 19-21

ROCHESTER, NY The 61st annual Rochester Hamfest/Computer Show, combined with the Atlantic Div./NY State ARRL Conv., will be held at Monroe County Fairgrounds, Rte 15A and Calkins Rd. Radio and comm. equip., computer equip., and supplies. Setup Fri. May 19th at 6 AM. Indoor exhibits open at 8:30 AM each day. Hotel accommodations at the *Marriott Thruway Inn, (716) 359-1800.* Mention "Hamfest" when making reservations. Send ticket requests to *Irv Goodman AF2K, 515 Drumm Rd., Webster NY 14580.* Make checks payable to Rochester Hamfest. For info, call the Rochester Hamfest office, *(716) 424-7184* during weekday business hours. For a brochure, call or write: *Rochester Hamfest, 300 White Spruce Blvd., Rochester NY 14623.*

MAY 20

CADILLAC, MI The Wexaukee ARC will hold their annual Hamfest and Eyeball QSO at the Cadillac Middle School starting at 8 AM. Talk-in on 146.98. For

info on tables, contact *Dan KE8KU, (616) 775-0998*, or *W.A.R.C., P.O. Box 163, Cadillac MI 49601.*

COLORADO SPRINGS, CO The Pikes Peak RAA will hold a ham radio Swapfest 8 AM-3 PM at Liberty H.S., 8720 Scarborough Dr., off Research Pkwy. Talk-in on 146.97/.52. For general info, call *Harv Hunter WA3EIB, (719) 597-8964.* VE Exams start at 9 AM. Bring current license (orig. & one copy), picture ID, and a check for $5.90. For info, call *Rick Brown KD0SU, (719) 531-9423.* Send SASE with a check payable to PPRAA to *Harv Hunter WA3EIB, 1437 N. Chelton Rd., Colorado Springs CO 80909. Tel. (719) 597-8964.*

EPHRATA, PA The Ephrata Area Rptr. Soc. will hold their 10th annual Hamfest starting at 8 AM at the Ephrata Sr. H.S., 803 Oak Blvd. Talk-in on 145.45. VE Exams. For advance reservations and info, write to *E.A.R.S., Inc., Clearview Ave., Ephrata PA 17522;* or call *Tom K3RZF at (717) 336-2514, after 6 PM.*

FESTUS, MO The Jefferson County ARC will hold a Cavefest, rain or shine, starting at 7 AM. Set-up Fri., May 19th, Noon-11 PM; Sat., May 20th, 4 AM-7 AM. Cave provided by Russ Bauman. Electronic/Radio/Computer Swapfest. VE Exams by pre-reg. Talk-in on 147.075, 224.040 and 442.500. For reservations, send payment with SASE to *Herb Metts, P.O. Box 232, House Springs MO 63051. Tel. (314) 671-0667.*

FORESTDALE, RI The Rhode Island Amateur FM Reptr. Serv., Inc. will hold their annual Spring Auction/Flea Market at VFW Post 6342 on Main St. The Flea Market opens about 8 AM. There will be an auction 11 AM-3 PM. Talk-in on 146.76. Contact *Rick Fairweather K1KYI, 144 Parkview Dr., Pawtucket RI 02861;* or call *(401) 725-7595, 7 PM-8 PM.*

PADUCAH, KY The Paducah ARA will hold its ARRL Major Event "Dukefest" at the Cherry Convention Center starting at 8 AM. Setup at 6 AM. Flea Market; Reserve tables early. Forums. VE Exams. Contact *David Fraser KQ4IU, 5715 Blandville Rd., Paducah KY 42001. Tel. (502) 554-7999.* Talk-in on 147.060.

MAY 20-21

DAYTON, OH Trade Show Productions, Inc. will hold the Cincinnati Computer Fair at Cincinnati Gardens, 2250 Seymour Rd., Cincinnati OH. Time: Sat. 10 AM-5 PM; Sun. 10 AM-3 PM. For booth sales and info, call *(513) 263-3378.* Make checks payable to *Trade Show Productions, Inc.*, and mail to *Mark Hanslip, 143 Schloss Ln., Dayton OH 45418.*

MAY 21

CAMBRIDGE, MA A Tailgate Electronics/Computer/Amateur Radio Flea Market will be held 9 AM-2 PM at Albany and Main Sts., by the MIT Radio Soc. and the Harvard Wireless Club. For reservations and info, call *(617) 253-3776.* Mail advance reservations before May 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 pi 2A, W1XM/R.

WOODBURY, NY A Hamfest will be held at Briarcliffe College, 250 Crossways Pk. Dr., 9 AM-3 PM, by the Long Island Mobile ARC. VHF Tune-up Clinic. VE Exams 9:30 AM-10:30 AM. Talk-in on 146.25/.85. No advance tickets or tables. For more details, call *Neil Hartman WE2V, (516) 462-5549*, or *Mark Nadel NK2T, (516) 796-2366.*

MAY 26-28

TULSA, OK Maxwell Convention Center, Exhibit Hall A, W 7th St., between Denver Ave. & Houston Ave., is the location for the 1995 Green Country Hamfest & ARRL Oklahoma State Convention. Flea Market. Banquet ($20 advance reservation required). VE Exams Sat. & Sun. Forums. Storm Spotters meeting sponsored by the Nat'l Weather Service. ARRL meetings. Activities for non-hams. Talk-in on 146.88. Open autopatch on 145.27 during the event. Special hamfest discount at Double Tree Hotel across the street. Write to *Green Country Hamfest, Inc., P.O. Box 470132, Tulsa OK 74147-0132.* Dealers call *Charlie, (918) 241-4214.* For general info, call *(918) 272-3081; leave msg.* Also E-mail:*Merlin WB5OSM via Compuserve 73564,1063.*

MAY 27

DURHAM, NC The Durham FM Assn. will hold its 21st annual Hamfest/Computer Show at the South Square Shopping Mall, Highway 15-501 South and Chapel Hill Blvd., 8 AM-3 PM. Setup at 6:30 AM. VE Exams at 10 AM, pre-reg. requested. Exam contact is *Dave Snyder N2MLU, 600 S. Churton St. #64, Hillsborough NC 27278. Tel. (919) 644-8681.* Talk-in on 147.225(+600) and 145.45(-600). For Flea Market info, contact *Rodney Draughon KD4KMI, RT 4, Box 205, Rougemont NC 27572. Tel. (910) 364-7420.*

MAY 27-28

CASPER, WY The Wyoming State ARRL Hamfest will be sponsored by the Casper ARC Inc. Location: The Parkway Plaza, just off Interstate 25 and Center St. Banquet Sat. night. For details, contact: *C.A.R.C. Inc., W7VNJ, P.O. Box 2802, Casper WY 82602;* or *Steve Spier N7JUO, 3511 Swanton Ave., Casper WY 82604, Tel. (307) 265-6575;* or *Jim Boyer N7VLM, 2904 Meadow Dr., Casper WY 82604. Tel. (307) 237-0744.*

MAY 28

BALTIMORE-WASHINGTON, MD The Maryland FM Assn. will hold their annual Memorial Day Hamfest at the Howard Co. Fairgrounds, MD RT #144, West Friendship MD, from 8 AM-3 PM. Table reservations paid in advance only. Contact *Melvin Seyle WA3KZR, 15809 Pointer Ridge Dr., Bowie MD 20716. Tel. (301) 249-6147.* Talk-in on 146.76, 224.76, and 444.00.

CHICAGO, IL The Chicago ARC will hold its annual Hamfest at DeVry Inst. of Tech., 3300 N. Campbell, 8 AM-3 PM. Setup at 6 AM. Talk-in on 147.255(+), 444.825(+). Outdoor Swapfest. For

reservations and info, call *(312) 545-4740;* or *(545) 3622;* or leave a message on *(312) 666-1606.* Write to *CARC, 5631 W. Irving Pk. Rd., Chicago IL 60634.*

SOREL-TRACY, QUEBEC, CANADA The Quebec Hamfest will be held in Sorel-Tracy at the Curling Club. For more info, write to *Club Radioamateur Sorel-Tracy, C.P. 533, Sorel, Quebec J3P 5N6, Canada.*

JUNE 3

GRAND RAPIDS, MI The annual IRA Hamfestival will be held at the Hudsonville Fairgrounds, 5 mi. west of Grand Rapids. Doors open at 8 AM. Setup at 6 AM. VE Exams at 8:30 AM, walk-ins only. Talk-in on 147.16 link Rptr. system. Book reservations early. Contact *Tom KA8YSM,* or *Kathy KB8KZH, (616) 698-6627;* or write to *IRA, 562 92nd St. SE, Byron Center MI 49315.*

KITCHENER, ONTARIO, CANADA The 21st annual Central Ontario Amateur Radio Fleamarket will be held at Bingeman Pk., 1380 Victoria St. North, starting at 8 AM. Setup at 6 AM. Talk-in on 146.97(-) and 145.21(-). For tickets and tables make checks payable to Central Ontario Amateur Radio Fleamarket, and send to *Ted Eaton VE3GJE, 102-21 Woodlawn Rd., E., Guelph Ontario N1H 1G6, Canada. Tel. (519) 823-1027. Packet: VE3GJE@VA3RWP. #SWON.ON.CA.NOAM. Internet:eeaton@uoguelph.ca.*

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest at Fairleigh Dickinson Univ. Technical Seminars. ARRL Forums. VE Exams; call *Bob Neukomm, (201) 427-3568 before 10 PM.* For Hamfest info call *Jim Joyce, (201) 664-6727.*

WILMINGTON, NC The 3rd annual Ham Radio/Computer Equip. Seafest will be held by the Azalea Coast ARC at Trask Coliseum at UNCW, 9 AM-3 PM. Talk-in on 147.180(+). VE Exams by ARRL-VEC; walk-ins welcome. Bring picture ID, copies of certificates and current license. Testing is scheduled for 10 AM; for info contact *Sam Franklin KB4IL, (910) 791-0484.* For general info, contact *A.C.A.R.C., P.O. Box 4044, Wilmington NC 28406. Tel. (910) 686-4325 nights.*

JUNE 4

BUTLER, PA The 41st Breezeshooters' Hamfest will be held 8 AM-4 PM on the Butler Farm Show grounds. Talk-in on 147.96/.36. To reserve Flea Market tables, send check for $15 per table and an SASE to *Rey Whanger W3BIS, 5530 Cove Run Rd., Cheswick PA 15024-9451.* For General info call the *Breezeshooters' Hotline at (412) 828-3694.*

CONTOOCOOK, NH A Flea Market will be held by the Contoocook Valley Radio Club, 8 AM until ?? For details call*(603) 224-3899,* or *(603) 746-4817.* Talk-in 2m 146.895(-) or 146.94(-), and 52 simplex.

PRINCETON, IL The Starved Rock Radio Club Hamfest will be held at the Bureau County Fairgrounds, starting at 6 AM. Flea Market. Camping. Talk-in is on 146.355/.955. Contact *Bruce Burton KU9A,* or *Debbie Burton N9DRU, 1153 Union St., Marseilles IL 61341-1710. Tel. (815) 795-2201.*

SPECIAL EVENT STATIONS

MAY 6

CHANCELLORSVILLE, VA The Mt. Vernon ARC will operate NJ4F from "no man's land" on the original battlefield, to commemorate the 132nd Anniversary of the Civil War Battle of Chancellorsville. Operation will be in the General portion of the 40 and 20 meter phone bands. For a certificate, send QSL and SASE to *MVARC, P.O. Box 7234, Alexandria VA 22307 USA.*

KEYPORT, WA The North Kitsap ARC will operate WO7B 1600Z-2400Z to commemorate the opening of the Mines and Torpedoes exhibit at the Naval Undersea Museum. Operation will be in the lower end of the 40, 20, 15, and 10 meter bands. For a QSL, send QSL and SASE to *Robert J. Tomas N7KTP, 38119 Vista Key Dr. NE, Hansville WA 98340 USA.*

MAY 6-9

FLOYD, VA The Foundation for Amateur Internat'l Radio Service (FAIRS) will operate KK4WW, US5WE, UA4LCQ, 8R1WD and S21AM in their own countries 1400Z May 6th-1400Z May 9th, to celebrate the 4th Anniversary of FAIRS. Operation will be in the General portion of 40, 20 and 15 meters. For a certificate, send QSL and a 9" x 12" SASE to *FAIRS, P.O. Box 341, Floyd VA 24091 USA.*

MAY 7-21

HOLLAND, MI The Holland ARC will operate K8DAA to celebrate Tulip Time. Operation will be in the lower portion of the General 20 and 15 meter subbands, and at 28.400. For a certificate, send QSL with call signs worked, and a 9" x 12" SASE to *Barbara Siebelink N8NXA, 6418 Otis Rd., Saugatuck MI 49453 USA.*

MAY 20

KODIAK ISLAND, AK The US Coast Guard ARC will celebrate Armed Forced Day by operating KL7HKX in the General class bands. Look for operators on the 20m band on 14.260 (IOTA frequency). To receive the Coast Guard ARC QSL card, use the following QSL info: *S/A/S/E please or via ARRL Bureau, United States Coast Guard ARC KL7HKX, P.O. Box 190421 USCG, Kodiak AK 99619-0421 USA.*

MAY 20-21

SAN BERNARDINO, CA The Citrus Belt ARC will operate W6JBT 1700Z May 20th-1700Z May 21st, to commemorate the Civilian Conservation Corps. activity in the San Bernardino Nat'l Forest 62 years ago. W6JBT will operate in the General portion of the 80 to 15 meter phone, Novice 10 meter phone subbands, and 2 meter packet. For a certificate, send QSL and 9" x 12" SASE to *W6JBT, P.O. Box 3788, San Bernardino CA 92413 USA.*

MAY 20-22

OAK PARK, MI The 1995 Michigan QSO Party will be sponsored by the Oak Park ARC. Operations will be 1800Z Sat., May 20th-0300Z Sun., May 21st; and 1100Z Sun., May 21st-0200Z Mon., May 22nd. Frequencies: CW - 1810, 3540, 3725, 7035, 7125, 14035, 21035, 21125, 28035, 28125. Phone - 1855, 3905, 7280, 14280, 21380, 28480. Contact *Jeffrey Albrecht N8WRY, 16193 Locherbie, Beverly Hills MI 48025* regarding logs; or *Oak Park ARC, 14300 Oak Park Blvd., Oak Park MI 48237 USA,* for rules.

MAY 22-27

VAN ALSTYNE, TX Amateur astronomers/Hams representing the southwest region of the Astronomical League will be operating Station K5GH at the 17th annual Texas Star Party. Operation will be +/- QRM: 28365, 21365, 14265 and 7265. SSTV and CW contacts on request. For an astronomical theme QSL card, send QSL/SWL report and SASE to *K5GH-TSP, 2619 Bordeaux, McKinney TX 75070 USA.*

MAY 27-28

CLARE, MI The Clare County ARES/RACES group AA8KP will operate 1200Z-0000Z to commemorate the 11th Wildlife Festival of Clare County. Operation will be in the lower portion of the General bands 15—80 and Novice 10 meter voice. For a certificate, send QSL and a 9" x 12" SASE to *Clare County EC, P.O. Box 262, Farwell MI 48622-0262 USA.*

SUMTER, SC The Sumter ARA will operate their annual Iris Festival Station, KQ7E, from the world famous "Iris Gardens," 2 PM EDT on the 27th-2 PM EDT on the 28th. Listen for them on the Lower 30 kHz on the General portions of 75, 40, 20, and on 28.300 thru 28.500. For a certificate, send $1 to *The Sumter ARA, P.O. Box 193, Sumter SC 29150 USA, ATTN: Special Event.*

VICKSBURG, MS The Vicksburg ARC will operate N5QDE in conjunction with the Reenactment of the Siege of Vicksburg Civil War Battle. Operation will be in the General phone portions of 40, 20, 17, and 15 meters, and 28.465. For a special QSL card, send QSL and SASE to *Ed Magruder, 2485 Warrenton Rd., Vicksburg MS 39180 USA.*

MAY 29

ELGIN, IL The Elgin ARS will operate W9IKN to commemorate the annual running of the Valley Fox Trot 10 mi. race. Operation will be 1200Z-1700Z in the lower portion of the General subbands, on SSB and CW. 6 meters SSB, propagation permitting. For a certificate, send QSL and Business size SASE to *E.A.R.S., P.O. Box 1351, Elgin IL 60123-1351 USA.*

JUNE 4

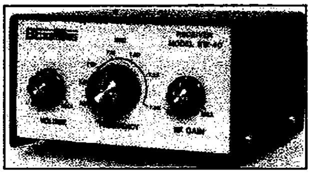
PLYMOUTH, CT Radio amateurs in Plymouth will operate designated stations to celebrate the bicentennial of the Town of Plymouth. A limited number of special certificates are being made available by the *Bicentennial Committee* to commemorate the contact. Operation will be in the General portions of 160, 80. 40, 20, 15, and 10 meters as propagation allows. QSL with an SASE to *K1EM, P.O. Box 12, Pequabuck CT 06781 USA.* Include a shipping container large enough to hold the 9 1/4" x 13 3/4" certificate, or a No. 10 business envelope for a folded certificate; along with sufficient return postage. 73

Number 26 on your Feedback card

NEW PRODUCTS

Compiled by Mike Nugent WB8GLQ

BOYD ELECTRONICS



Boyd's new RW Series receivers offer an excellent means of setting up a low cost station for QRP operation on 20, 30, 40, and 80 meters.

True superheterodyne direct conversion receivers, they provide excellent frequency stability, with no drift during operation.

The single circuit board features the NE602 mixer IC, popular among amateur receiver builders. An easily adjustable two-stage input preselect filter reduces out-of-band and harmonically related signals, and with an approximate 0.1µV sensitivity, even the weakest CW, SSB, and AM signals can be heard. An input RF GAIN control following this filter reduces overloading from strong nearby stations.

A six-pole audio bandpass filter with a low frequency cutoff of 250 Hz and high frequency cutoff of 2 kHz reduces hum and low frequency noise, and provides good station separation. The LM380 audio amplifier IC assures excellent audio quality and up to 2.5 watts of audio power when used with an 18V power supply.

The receiver oscillator is isolated by a buffer amplifier and provides an external counter for monitoring the receiver's frequency.

The circuit board and front panel adhesive decal are designed to be used with the Radio Shack 270-253 cabinet. Cabinet, power supply adapter, knobs, power switch, connectors, and hardware are not supplied but are available from Radio Shack.

For more information, contact *Boyd Electronics Co., 1998 Southgate Way, Grants Pass, OR 97526; (503) 476-9583.* Or circle Reader Service No. 201.

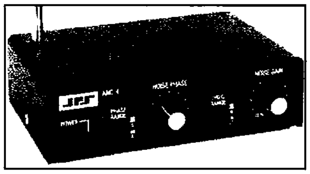
MICROTEK

Ever wish your Ramsey FX146 2 meter radio had some commercial-rig-style bells 'n' whistles? Well, with the RC2 Radio Controller add-on from Microtek, it will.

It'll have a 12-button keypad, 7-segment LED display, 20-channel memory, fast scanning (100ms/channel), direct entry of any frequency from 140.000 to 179.995 MHz, and the ability to set standard repeater offset with the push of a button.

The RC2 comes with a 68HC11 microcontroller board that plugs into the radio's PLL socket, a display board that houses the display, keypad, status LEDs, and a new front panel. The only wiring needed is +12V, GND, CD (carrier detect), and PTT, all of which are easily tapped off the radio. The RC2 uses the radio's original volume and squelch controls, and mike and speaker jacks. The main board and display board connect via a 26-conductor ribbon cable, and everything is designed to fit into the original case.

The price is $110 plus $4 S&H (VA residents add sales tax). For more information, contact *Microtek, RR3 Box 4361, Bumpass, VA 23024; (703) 872-7020.* Or circle Reader Service No. 205.



JPS COMMUNICATIONS

From JPS Communications, Inc. comes the new ANC-4 Antenna Noise Canceller. Installed at your receiver/transceiver's antenna connector, this RF device cancels locally generated noise (power line noise, computer/TV noise, electrical noise from local machinery, etc.) from signals received by a primary antenna.

By removing the noise before it gets into the receiver and affects the receiver's AGC circuits, it allows reception of signals well below the noise level induced by the interference.

It works by detecting the local interference signal, matching its amplitude but reversing its phase, thereby cancelling the interference. Front panel controls provide phase and amplitude adjustment, for extremely deep cancellation of the offending signal.

The unit works with any receiver/transceiver with up to 150W PEP output power. A built-in RF detector automatically bypasses the unit whenever transmit RF is detected. (For use with a high power linear amplifier, the unit must be installed at the lower RF level of the transceiver, if transmitting is anticipated.)

The ANC-4 connects between the main station antenna and the receiver/transceiver's antenna connector. A short wire antenna and a short collapsible whip are supplied with each unit to act as a noise pickup antenna. If no main station antenna is available, the ANC-4 can function as an active antenna by plugging the noise antenna (or a longer wire antenna) into the noise antenna jack and using the NOISE GAIN control to increase the antenna output. The unit requires 12VDC @ 300 mA. Adapters are available from JPS.

For more information, contact *JPS Communications, Inc., PO Box 97757, Raleigh, NC 27624-7757; (919) 790-1011, FAX (919) 790-1456.* Or circle Reader Service No. 202.

TELEX COMMUNICATIONS

Telex introduces the DCU-1 Pathfinder, a state-of-the-art Digital Control Unit for Hy-Gain antenna rotators. Designed to be used with the Ham IV and T2X Tailtwlster, it is also backwards compatible with any 8-wire Hy-Gain rotator, such as the Ham II or Ham III.

Featuring digital bearing readouts to 1 degree, motor slowdown and eight-second automatic brake delay, it also offers automatic calibration and selectable center of rotation.

Six programmable memory presets let you program favorite beam headings, highly desirable for contesting, DXing, and VHF/UHF work. You can easily re-set the memories at any time.

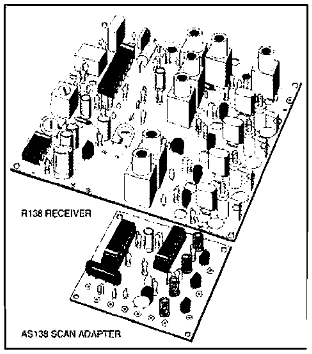
RS-232 compatibility allows rotator control from your computer, and a serial pass-through capability lets you connect your radio, terminal TNC, modem, etc., to this serial port. A 60-line BASIC control program comes with the manual, and a free information package for software developers is available from the factory.

The DCU-1 and rotator are available in both 110 VAC and 220 VAC versions, operating on 50/60 Hz.

Suggested retail price for the T2X (DCU-1 and T2X Tailtwister) is $799.99, for the Ham IV-D (DCU-1 and Ham IV) $749.99, and the DCU-1 by itself is $519.60. Interested amateurs should contact their favorite Hy-Gain dealer for price and availability information.

For more information contact *Telex Communications, Inc., PO Box 5579, Lincoln, NE 68505; (402) 467-5321, FAX (402) 467-3279.* Or circle Reader Service No. 203.

HAMTRONICS



It is well known that Hamtronics, Inc. makes a very effective wideband FM receiver module for 137 MHz weather fax reception. The new R138 Receiver now has a companion accessory, the AS138 Scan Adapter Module.

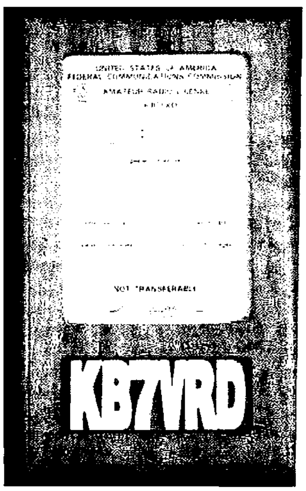
The crystal-controlled R138 Receiver has four channel oscillators. You select a particular satellite simply by grounding the desired control line with an external switch. Crystals, available for all the common satellites, simply plug into sockets on the board.

The new AS138 Scan Adapter lets you monitor the various weather satellites while you're away from the shack. Consisting of a small PC board, it continually monitors the receiver, scanning the four channels. If it hears an active satellite overhead, the scanner stops on that channel and turns on a relay. The relay can be used to activate a tape recorder, letting you play back the tape into your demodulator unit whenever you have the time to reproduce the satellite images on your computer.

At only $129, the R138 Receiver kit is quite a bargain. It is also available wired and tested for $189. The AS138 Scan Adapter Module is $39 in kit form, $69 wired and tested. Channel crystals are only $12 each, making this channelized approach much less expensive than synthesized receivers, even if you need to buy several crystals for the satellites you want to hear. And you'll get a lot of satisfaction doing the assembly yourself.

For more details, contact *Hamtronics Inc., 65-F Mould Rd., Hilton, NY 14468-9535; (716) 392-9430, FAX (716) 392-9420.* Or circle Reader Service No. 206. Please tell them where you saw this announcement. You will receive a complete data sheet, including preamps and helical resonator filters for the 137 MHz band. They also have copies of the *Weather Satellite Handboook.*

SHACK ATTACK



Display your amateur radio license in style, with this Callsign License Plaque. Handcrafted from alderwood and hand-finished with two coats of polyurethane gloss for a beautiful, natural appearance, this handsome dark wood plaque is a great way to meet FCC Section 97.3 station license requirements while enhancing the looks of your shack.

This 7.25" x 12" plaque includes a 5" x 7" clear Plexiglas cover for your license, cardboard backing, self-leveling picture hanger hardware, and—of course—your callsign inset below in large 2" pine letters.

The Callsign License Plaque is available for $19.95 plus $3.50 S&H. For more information, contact *Shack Attack, 1394 N 770 W, Dept. 49, Orem, UT 84057-5903; toll-free (800) 573-7388; E-mail: kb7vrd@aol.com.* Or circle Reader Service No. 204.

BARTER 'N' BUY

Number 27 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Joyce Bocash, *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls.

The deadline for the July 1995 classified ad section is May 11, 1995.

Continued on page 82

PROPAGATION

Number 28 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

Special Forecast This Month

Ma Nature seems to have conspired this month to make every weekend of the month Poor (P) or Fair (F) or trending to either of these conditions. Blend that with the general movement away from Spring Equinox (good) to Summer Solstice (poor) for the HF bands, and you have a mix that will conspire to make you really work for the DX. Add to that gloomy outlook the rapid decline of Sunspot Cycle 22 to its expected nadir at the end of this year or early in '96, and you have "band conditions" that haven't been so bad since the last Cycle 21 at about this time in its progress.

However, that doesn't mean there won't be any DX at all . . . it just means you'd better sharpen your skills in these areas: weak-signal copy, careful listening at *all* times, and close attention to WWV and their forecasts at 18 minutes after each hour. I use the 10 MHz frequency because of its convenience and the usually good signals here.

On the *plus* side, you may well find Sporadic E propagation on some days as high as 10 meters, with strong skip signals suddenly fading. Also, even on a dead-sounding band, you ought to give at least one or two COs, as results could be very surprising.

For this month, those who are retired, or have weekdays available, will do better than those who can operate only on weekends. Don't give up . . . better times are ahead . . . but you may have to wait a few years.

10 and 12 Meters

Occasional F2 openings to the Southern Hemisphere during daylight hours. The bands close at sunset.

15 and 17 Meters

Consistent openings to Africa and Latin America, and short skip to about 1,000 miles during daylight. Bands close at sunset or shortly after.

20 Meters

Your best band for DX to all areas of the world between sunrise and well past sunset, and short skip to 2,000 miles during daylight hours.

30 and 40 Meters

Good DX from slightly after local sunset to just before local sunrise. Signals from the east peak between sunset and midnight, and from all other areas between midnight and sunrise. Daytime short skip to 1,000 miles, and nighttime skip to 2,500 miles.

80 and 160 Meters

Good DX from sunset to sunrise on nights of low atmospheric noise, and skip to 2,000 miles or so. Requires vertical transmitting antennas and horizontal (preferably Beverage) antennas for best results on receiving. Little, if any, daylight activity on 160, but some on 80 meters.

MAY 1995						
SUN	MON	TUE	WED	THU	FRI	SAT
	1 G-F	2 F	3 F-G	4 G	5 G-F	6 F-P
7 P	8 P	9 P-F	10 F	11 F	12 F-P	13 P
14 P-F	15 G	16 G	17 G	18 G	19 G-F	20 F
21 F	22 F-G	23 G	24 G-F	25 F-P	26 P	27 P
28 P-F	29 F-G	30 G	31 G			

GMT	00	02	04	06	08	10	12	14	16	18	20	22
EASTERN UNITED STATES TO:												
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		
CENTRAL UNITED STATES TO:												
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			
WESTERN UNITED STATES TO:												
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

73 Amateur Radio Today

JUNE 1995
ISSUE # 417
USA $3.95
CANADA $[illegible].95
A WGI Publication
International Edition

SUPER CW STATION!

BUILD YOUR OWN . . .

Battery Monitor & Charge Controller

Tone Burst Generator

Morse Code Keyer

2m 5/8-Wave Collinear Omni Antenna

73 Reviews

AEA KK-1 Keyer

SGC Longwire Antenna Tuner

Swiech Yagi

06
0 74851 08725 1

THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

MANAGING EDITOR
Hope Currier

SENIOR/TECHNICAL EDITOR
Mike Nugent WB8GLQ

EDITORIAL ASSOCIATE
Joyce Sawtelle

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Mike Nugent WB8GLQ

GRAPHIC DESIGN
Suzanne Coté

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

GRAPHICS MANAGER/ PAGINATION
Linda Drew

CIRCULATION
To subscribe: 1-800-677-8838

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*. Reprints, 70 Route 202N. Peterborough, NH 03458.

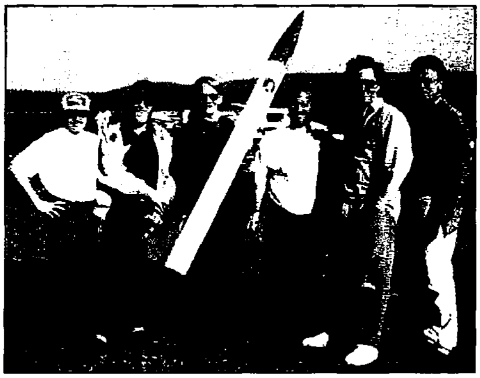
Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

June 1995
Issue #417

TABLE OF CONTENTS

FEATURES



These guys are preparing to launch an ATV rocket that will eventually land amidst a herd of cows. See page 64 for the details.

REVIEWS

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: This ain't no ordinary, run of the mill keyer. Nope. It's a Super CW Station, complete with clock, calendar, alarm (it alerts you with your own CW messages), Morse code reader, keyer with adjustable sidetone, random Morse code practice generator . . . and more. And you can build it! Tune in to page 10 for details.

FB

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: Even the most cursory glance at this text is sufficient to bind you, morally and legally, to take a kid (or kids) along on Field Day, get 'em fired up on amateur radio, and then help 'em get started toward a license. You'll feel good about yourself, and our legal counsel won't have to hassle you.—Nuge WB8GLQ

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

DXpedition, Anyone?

Well, perhaps that's an exaggeration. What I have in mind is a 25-day whirlwind visit to several Pacific islands for some hamming and scuba diving. Any divers with this November to spare for a trip?

The plans are to fly to Majuro first, spend a couple days hamming and diving, then on to Pohnpei for four days of same. Then to Truk for four more days, Yap for three days, and Palau for three days. Well, I said it was a whirlwind trip. But that should be enough to get in 16 days of diving and hamming and nine days traveling.

Some time ago, egged on by Robbie 5Z4ERR, I planned an African hunting safari, followed by a trip on around the world (which didn't cost much more than just flying back), I managed to talk two other hams into going along. We all had a ball! I'm editing the report I wrote on that trip, and I've got a ton of photos to go with it. That'll make a book all by itself. I ran into Jim Cotten recently and he said that that was the trip of his lifetime.

Yes, we shot game in Kenya. We had a great visit to Uganda. And Afghanistan, Iran, Iraq, and so on. I got on the air everywhere I could . . . like Lebanon, Kenya, Iran, Nepal, Syria, India, Singapore, Tahiti, and so on. This time I'll be visiting six Pacific countries and I'd love to have the company of a couple of ham-divers. You've got to be good divers. This stuff isn't for sissies. My wife Sherry will be with us, but she doesn't dive.

If you know or run across any hams who are active on these islands, please let me know so we might be able to use their stations instead of our having to lug a ham rig all over the Pacific. I'll have enough to carry with all my diving equipment and my underwater video camera. We'll be stopping in Honolulu and Guam overnight, if there are any ham clubs who'd like to get together with me (or us).

So, anyone with a few weeks available who'd like to bask on some Pacific islands with me? If you've read any of my travel reports you know that Sherry and I travel cheap.

Stop That Noise!

Yes, it's opportunity knocking again. The noise is getting on our nerves as we get pushed and shoved, our heels gouging long tracks, further into the vaunted information age.

Here we are, looked upon by what few of the public have even heard of amateur radio, as communications and electronics experts. If they only knew! Well, I'm not going to tell them that one of our main preoccupations these days is in trying to return to the womb. Our Newington-based leadership, heads firmly planted in the sand, are frantically hanging on to the code as a way to keep new hams out of their preserves. Ham radio started with spark transmitters, and they used the Continental Code to communicate, since voice couldn't be modulated on a spark transmitter. "Spark Forever," was the oldtimer's cry of the 1920s. That cry hasn't changed much. Now it's "CW Forever!"

Let's be practical about this. If you were a teenager today you would be reading about the Internet, seeing ads everywhere for CompuServe, and be getting free disks and a few free hours of connect time to get on America On-Line and Prodigy. With a modem you'd soon find yourself chatting with people almost anywhere in the world, and all in real time. No QRM, no lousy band conditions. No tower, beam and kilowatt rig needed.

Ham radio? Isn't that something like CB? When is the last time you saw an article in a major magazine about amateur radio? Oh, we make the newspapers here and there, now and then. But that doesn't compete with the Nintendo and Sega ads. It doesn't mean much compared to the online services stories we see every week in almost every news magazine.

Yes, I'm critical of our *only* national organization refusing to spend some of the millions of dollars they've squirreled away for a rainy day, while completely ignoring the storm clouds gathering. We need a well-planned national promotion of amateur radio, with articles by well-known hams in the major mass magazines, on the radio, and on television. We need to organize national amateur radio events.

I'm not talking about spending a zillion dollars either. Public relations (PR) is the cheapest form of advertising there is. I've a $50 video I made showing how any company can generate an extra million dollar in sales for peanuts, just with the intelligent use of PR.

We have a ton of things to tell the public, it's just that we have no organization that's doing anything about it. That nine-year-old Extra Class girl should have at least been on the Today Show. Ham DXpeditions would make fascinating articles for travel magazines as well as the general media. If we had one retired professional PR ham we could turn loose, that's all it would take.

I hired an experienced PR chap a few years ago and he had no problem in getting me on the radio and TV with one interview after the other. He had me speaking to Lion's Clubs, Kiwanis, Rotary Clubs, Chambers of Commerce, and lecturing at Yale, Boston University, and a bunch of other colleges. A good PR person can call up the networks and get through to the right people.

We'll start attracting new hams if we mount a national promotion for amateur radio. Without it we're going to keep on being virtually unknown. If you don't agree with me that we should aim for at least five million hams, I'd like to know why. As I've pointed out, we are at present using less than 0.13% of our ham bands on any kind of a regular basis. Do you think for a minute that the FCC isn't well aware that we are a bunch of doddering old white men with the private use of billions of dollars in spectrum?

So what do we do? We keep poking the Commissioners in the eye with a pointed stick, wringing our hands over Baxter and his stupid ego trip, over repeater wars, bad language on 14.313, and other idiocies. And in case the Commissioners don't get the message, we also complain to our Senators and Congressmen, knowing they haven't a clue as to what amateur radio is, and will merely forward the complaints along to the FCC, adding to their frustration with us.

I am old enough so I can remember when the public knew what amateur radio was and there was prestige in being a ham operator. Yes, I have a long memory. Now I'm afraid that I may outlive amateur radio. Will we even have a hobby in 10 years? I'd put the odds at around 20% right now.

I hate to keep saying the same thing over and over, but our country needs amateur radio desperately. We need to get our kids fired up when they are around 10 years old and thus encourage them to learn about electronics and communications because it's fun. In that way we'll have the high-tech career workers our country is going to need to compete in the 21st century.

If you are an ARRL member I wish you'd demand that they set up a PR office and get a national campaign started. Tell 'em that if they don't, you'll let your membership drop. Their magazine is good, but you can buy it on newsstands without being a member. And if you aren't a member, tell 'em you might consider membership if they were doing the job you expect of them.

They should be getting Jean Shepherd (K2ORS) to write humorous ham stories for *Playboy*. He won their humor award several years running with his stories, but they weren't about ham radio. And how about getting Andy Griffith, Barry Goldwater, and so on to help promote us? Or should we get Kevin Mitnick to write? He'll probably be in prison for a few years and have plenty of time.

Oh yes, I started to write about opportunities and got off, as usual, on a tangent.

The so-called information highway is more like an information garbage dump. Sure, there's tons of great information there to be found. The problem is finding it. And where there's a problem, there's an opportunity. You might start out by doing some articles for *73* on where and how to access ham radio groups on the Internet. With some organization we might end up with 73 different groups, one for each of the separate aspects of the hobby. For instance, the 80m DX crowd could use a QRM-free resource to get and give information about 80m DXing. Wouldn't it be nice to have a source for the calls and frequencies for hams around the world sending high-definition color pictures by slow-scan?

Hams could use the Internet to set up schedules for DXing, RTTY contacts, and so on.

There is going to be a long battle for on-ramps to the information highway. As users, we don't care if we use the telephone wires, cable, a local repeater, or a satellite dish. We do want to know what the pros and cons are of each system, and how we can best adapt to them. I'm expecting some articles.

Newcomers to the Internet are buying books by the ton to help them cope with this huge information garbage dump. They're looking for someone who knows his way through the forest to help guide them. That's an opportunity.

Will I be able to say in 10 years that I knew the top people involved, as I can say of computers? That's all up to you. If you prefer watching Murphy Brown and ball games on TV to making things happen, you'll never be a Bill Gates or a Steve Jobs. It's your choice. Take your ear plugs out and see what opportunity has to offer when you open the door.

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Clayton Schmitt N7DKZ/HP3, David, Chiriqui, Panama Wayne, although you're not aware of it, our association predates the time when *73 Magazine* sold for 37 cents. I've followed your editorials and capitulated to most of your prodding over the years. At your insistence I've gone RTTY, SSB, FM, QRP, repeaters and much more. Also, I have enjoyed building a sizable number of your construction projects.

I started out almost 50 years ago as WOKTX and over the years have been KL7GDQ, WB7ETO, and now N7DKZ. I am retired and live in David, Chiriqui, Panama.

I would like to present you with an idea for *73*. Over the years you've had myriad excellent articles in *73*. Due to a number of moves during my professional career, I have had to give away my library of *73* magazines several times, always shedding tears the approximate size of elephant fecal matter. I know that the entire life span of *73* is available on microfilm. This is an excellent media, but it does present problems. Copying an article or a schematic is not the easiest thing to do. This leaves you with the option of drawing free-hand, with all the accompanying errors, or doing without. Plus, the microfilm reader is a pain.

I assume that you have retained the publication rights for the entire life of *73*. Since you are already in the CD-ROM publication business, why not put *73* on CD-ROMs? Possibly you have sufficient articles on such topics as antennas to market an entire CD-ROM on the subject. Or, combining antennas with QRP and other subjects would be sufficient to fill a diskette. As a last option, republish the entire life span of *73* on CD-ROMs. I assume your supply of editorials would be sufficient to fill several CD-ROMs.

Another suggestion, if I may: Why not code new listings in Uncle Wayne's Bookshelf with an asterisk or something? This would make it convenient to keep up on new publications that you have for sale. I would still have to read your entire listing on, say, antennas if I wanted to buy an antenna reference book.

A last suggestion, then I will sign off: Reorient your editorials to ham related subjects. When I buy a ham magazine I couldn't care less about UFOs, ESP, NDE, cold fusion, or regular reruns of your trials and tribulations in the music publishing business. I want to be fully informed on the latest state of the art in ham radio. The other subjects generally turn me off.

With that I'll go back to helping members of the local ham radio club construct 2 meter antennas based on the "Copper Dual-Band Super J-Pole Antenna" described in KAØNAN's article in the April 1993 issue. Since I pay full price for my *73* subscription, I'm fully entitled to my opinion. I think *73* is a great magazine; however, your editorials burn up a lot of valuable space. Thanks for hearing me out.

Clayton—Go suck eggs ... Wayne

Paul Chapio KK5EF, Stephenville TX Wayne, Bravo on your "Never Say Die" column! My wife and I just returned from a trip to Malaysia and Singapore on a shoestring budget and had a ball. I highly recommend the mountainous areas of Malaysia, such as Cameron Highlands and Frazier's Hill.

I heartily agree with your challenge to people to explore and "get off their duffs." My wife takes care of six neglected and abused boys as our "job." With our small salary (albeit other immeasurable rewards), we surely have more fun than people earning multiples of our combined salaries. I am currently starting a radio club for our boys (if I may put in a plug—we need equipment). I feel that you and I are kindred spirits as I also have an entrepreneurial bent (I produced corporate videos for Fortune 500 companies in my previous life, before I "cashed out") and an appreciation of the arts, especially music. (I earned a B.A. in music while pursuing another degree because I was so fascinated by music—dual degrees!)

Anyway, my reason for writing is to express my opinions on the topic of boring QSOs. It seems a parallel exists in the arts. While pursuing my Master of Fine Arts degree, I had a professor named Charles Werberig at RIT in Rochester, New York, who had an exercise for graduate students who became too entangled in the *technology*. He would make them set down their Nikons, Sinar view cameras, digital light meters, and Zone System, and use a cheap plastic, non-focusable, non-adjustable camera called a Diana. The assignment: "Go out and shoot what is *important* to you!"

You see, we all stand the chance of becoming technicians, even in the arts. Amateur radio trains technicians, not effective or creative communicators. It's as though we've taught people to operate, troubleshoot, and even build their own printing presses, but they have nothing to say in print! My personal viewpoint is that the dilemma is beyond the scope of amateur radio—it's a people issue. People wishing to become more effective communicators can read more, go to journalism school, take creative writing courses, or practice art. But as long as the *Amateur Radio Handbook* remains a technical compendium, we are bound to have technically perfect (however boring) "emissions." (Look at our terminology.) Perhaps we should have all our boring Extra Class licensees shut down their legal limit stations and get out a CB walkie-talkie until they become more interesting people and talk about what is important to them. Otherwise, they may fall into the technology and never come back out!

You are inspiring! Thanks.

Rege D. Dvorsky WA3LKT, Grasonville MD Wayne, I would like to comment on the excellent "lightning/ grounding" articles you have had in *73* magazine over the last few months. I thought the articles were excellent and I know they have proved to be the same for many hams. I even had an old friend from Pittsburgh send me a copy (he didn't know I've subscribed).

I think every ham has gone through problems with grounding, RF in the shack, etc. As a matter of fact, I have just put in my own new grounding system, and it actually worked (potluck). Personally, I do not have money for luxuries such as VHF rigs for satellite operation, etc. I have enough problems keeping up my HF and 6 meter station. (I would love to get into satellite operating ... and I do track and listen to *AO-21* and *Mir*. I have also tried the satellite on 10/15 meters and have had no luck with my dipole antenna.) Anyhow, I think it would be great to have more articles that relate to the nagging problems all hams have had, such as TVI, grounding, operating tips, DX QSL routes, and hidden apartment-type antennas.

I would also like to see an article once in a while about shortwave listening, such as the "numbers stations" you briefly mentioned in the March issue. I listen to airline communications all the time and haven't a clue what they are talking about. Also, I live on the bay here and would love to know where the HF maritime frequencies are. I think listing some of these interesting stations would really spark some interest in your readers.

James Alderman KF5WT, Carrollton TX Wayne, I read your editorials regularly and often agree with you, so I thought you might like to hear about an interesting thing that happened to me not long ago.

Recently, while traveling out of the Dallas area, I was talking with a gentleman on one of the metro-area's most popular repeaters. This gentleman was a retired veteran. I happened to mentioned that I believe flag burning to be wrong, and that it is also wrong to have a dope-smoking draft dodger commanding our armed forces, something he agreed with.

Suddenly another station broke in to say that we shouldn't be mentioning a political comment on the air because somebody might be listening and not agree with it. "It might be divisive," the station said. Well, about this time I began to drop out of range, but I could hear hams from everywhere coming on board not only to agree with my comment but, more importantly, to agree with my *right to say it*.

This guy said that good amateur courtesy mandates that "sex, religion and politics" not be mentioned on 2 meters. I looked in all my ham books, and it's not there. I looked in part 97, and it's not there either. So the *fact* is that I have the same right to speak as anyone else. The only breach of courtesy would be if I were to express my conviction and refuse to allow anybody else to have their turn on the repeater.

Now, on this repeater I have heard every view, from legalizing drugs to outlawing high school sports. In fact, the club that owns the repeater used to have an issue discussion net on the air; the day I heard it the subject was, "Should we have rebuilt Japan after defeating them in WWII?" And who could forget the lively discussion that ensued the day that "codeless licensing—pro or con" came up.

I remember when your magazine carried this question: "Think about the most interesting talk show that you've ever wanted to call in to, and ask yourself this: Why can't morning drive time on the repeaters in America be just that interesting?"

You're right, Wayne. Most of the conversation on repeaters amounts to a bunch of nothing. I like issue discussions—they challenge me to think and I always end up learning something by listening to varied views. Sad to say, very little stimulating conversation happens on ham radio.

When I told a non-ham friend how I had been chided for my remarks, he said, "I didn't want to tell you this but that's exactly why I have never wanted to get my ham license. All the times I've ridden with you I've never heard anything on that radio worth listening to." When I reminded him that he might need the radio in an emergency, he replied, "I've driven all over Texas—even into far west Texas—and have never driven out of cellular phone range." What could I say, Wayne? He was right.

You know, if intelligent and educated people stay away from amateur radio in droves, if we continue to scarcely utilize our valuable frequencies, rarely home-brewing our own gadgets or coming up with anything innovative, talking about nothing on the air and roasting those who wish to do otherwise, running off more people than we attract, can we be surprised if we lose all our bands to commercial interests? And if that happens, do we have anybody to blame but ourselves?

Atlee Kohl, Irving TX Wayne, your March 1995 editorial on the Internet was "too close for comfort." I've thought more than once about dramatically downsizing my own ham radio activities—in terms of both time and equipment—to allow for "Internet ops" on a variety of specialized subjects that greatly interest me. As you pointed out, ham radio could be there and beyond if wise decisions had been made by our ARRL leadership over the last three decades.

QRX . . .

Number 3 on your Feedback card

Free SSTV Handbook on the Internet

During the past couple of years, SSTV activity has been growing by leaps and bounds. It was always fun, but now it is no longer complicated and expensive. Unfortunately, it is difficult to find much accurate modem information.

John Langner WB2OSZ has written a short handbook to help combat this lack. It contains sections on how it all began in 1957; how to get started for only a couple of dollars or less; questions and answers; typical color images; commercial products; home-brew products; bibliography, glossary, and much more.

All this is available for free in electronic form on the World Wide Web. The Universal Resource Locator (URL) is http://www.ultranet.com./~sstv. The author can be reached at johnl@world.std.com. *TNX John Langner WB2OSZ.*

SAFEX On Upcoming *Mir* Mission

A meeting was held in Moscow March 24 to 29 on matters relating to the SAFEX Project, with DL3LUM and DL2MDE participating. The discussions centered around the "EUROMIR" Mission scheduled for August 1995. The German Thomas Reiter will spend 135 days on board *Mir.* He is now preparing in Russia for his ham radio license exam and is planning to be active on FM voice and packet during his flight. Schedules will be set up with schools. Operation will be on 70cm and 2 meters. The 2m antenna on *Mir* will soon be replaced with a dual-band antenna. SAFEX will provide equipment for the two bands, including 9600 baud packet which will be used on 70cm. The German/Russian SAFEX Project lists the frequencies to be used as: 437.975 packet and 437.925 FM voice for the downlinks and 435.775 for packet and 435.725 for voice for the uplinks. Thus both offsets will be -2.2 MHz.

The call used on 70cm only will be RRODL.

(The preceding information, originated by DL2MDE, was received by Ray Soifer W2RS from GB7HSM and was translated from the German by Gerd Schrick WB8IFM. The AMSAT News Service will carry more information on SAFEX as it becomes available.) *TNX AMSAT News Service (ANS), DL7MDE, W2RS, WB8IFM.*

New Ham Band

Ham radio has a new band. The FCC has released a Report and Order allocating the 219 to 220 MHz band on a secondary basis to the Amateur Service for point-to-point fixed digital message forwarding systems.

When the new rules take effect (date to be announced), Technician and higher class amateur licensees will be permitted to use digital emissions of up to 100 kHz bandwidth and up to 50 watts PEP output.

To protect the band's primary occupant, Automated Maritime Telecommunications Systems (AMTS), the Amateur Radio Relay League has been designated as the national contact point for all amateur operations in the 219–220 MHz band. Amateur stations must notify the ARRL at least 30 days prior to initiation of operations in the band. Within certain distances from AMTS coast stations, amateurs must obtain written approval of the AMTS licensee prior to operating. The ARRL will assist amateurs in fulfilling these requirements.

Amateurs operating in this band must not interfere with, nor are they protected from interference by, primary service operations in and adjacent to the band. *TNX ARRL.*

Best of 75 Net

No, you are not listening to another case of malicious interference on some Los Angeles area 2 meter repeater. Rather, this is a weekly on-air competition. It's found every Sunday night on the Best of 75 Meters Net, a place where representatives of all other frequencies can compete against one another to see which one has the strongest signal on the band. Literally a ham radio horse race!

But there is also a serious side to The Best of 75 Meters Net. Each week, net control station Don Simpson KO4TA brings on a well-known guest speaker over his autopatch. One of the first was W5YI VEC Administrator Fred Maia who fielded questions on a wide variety of topics, including the vanity callsign program.

The Best of 75 Meters Net meets every Sunday for at least three hours starting at 7 p.m. Eastern time. Look for it on 3.975 MHz, sit back and enjoy a grand old ham radio fun time! *TNX Amateur Radio Newsline, Feb. 27, 1994.*

SAREX Frequency Changes

Space Shuttle flight STS-71, to be launched in June, is the first to feature a docking between the Shuttle and the Russian *Mir* space station. Special Shuttle Amateur Radio EXperiment (SAREX) voice frequencies will be used.

The special frequencies are: Downlink: 145.84 MHz worldwide; and Uplinks: 144.45 and 144.47 MHz worldwide.

SAREX and *Mir* Amateur Radio stations normally share the same downlink frequency, which would cause interference on the STS-71 mission. Because of this and lessons learned from using particular frequencies during previous SAREX missions, the SAREX Working Group has made these changes for STS-71. The new frequencies were chosen after much deliberation to minimize interference between SAREX, *Mir*, and terrestrial stations.

Most SAREX operations are split frequency, with a downlink (astronauts transmitting to Earth stations) and an uplink (Earth stations transmitting to astronauts). Listen to the downlink and transmit only when the shuttle is in range and astronauts are on the air.

Mir operations are simplex and remain on 145.55 MHz.

Before transmitting, listen to the SAREX uplink to avoid interfering with others, and listen for the astronauts' instructions about frequencies they're using. They won't favor a specific uplink, and your ability to work them will be "the luck of the draw."

If these special SAREX frequencies prove acceptable, they will be used for future docking missions. Note, however, that there is a strong chance that STS-70 will fly before STS-71; if so, STS-70 will use the regular SAREX frequencies. *TNX ARRL Space Bulletin 005 ARLS005, April 5, 1995.*

FAR Scholarships

The Washington, DC, based Foundation for Amateur Radio is once again coordinating the distribution of 56 scholarships for the 1995–1996 academic year. Licensed radio amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school. Applicants must be accepted for enrollment in an accredited college, university, or technical school. The scholarships range in value from $500 to $2,000 each.

For more information please write to the Foundation for Amateur Radio, 6903 Rhode Island Ave., College Park, MD 20740.*TNX Ham Arundel News. April 1995.*

Petition threatens W1AW

A petition for rule making before the FCC would eliminate all one-way transmissions such as code practice and information bulletins on the amateur bands below 30 MHz, including those from W1AW.

The petition, filed by Frederick O. Maia W5YI, publisher of the *W5YI Report* newsletter, seeks to eliminate the rules permitting one-way information bulletins and Morse code practice in the amateur bands below 30 MHz. The effect would be to silence W1AW bulletin and code practice transmissions, among others.

Maia calls the FCC rule permitting certain one-way transmissions on the amateur bands "a very permissive category and taken in its broadest context, permits just about anything to be transmitted that is even remotely associated with the Amateur Service."

He says that code practice is now available on computer software, and information bulletins about amateur radio can be had on various computer on-line services.

Comments on the petition may be sent in the form of a letter to the Secretary, FCC, Washington, DC 20554. The file number, RM-8626, should be shown prominently at the top. An original and five copies is preferred, but single-copy comments will be accepted. *TNX ARRL.*

Number 4 on your Feedback card

The N4UAU Super CW Station

by Sam Ulbing N4UAU

Look, over in that ham shack! "Why, it's a clock!" "No, it's a keyer!" "No, it's a CW tutor!"

"No, it's the N4UAU Super CW Station!"

If you are a new ham or want to upgrade your ticket, this project will help you master CW. If you are an experienced ham, you will learn to send better and improve your ability to copy in your head. And you will find the receiver function to be a *fun* way to look around the bands while improving your ability to copy code. Whether you are new or experienced, the built-in alarm clock will keep you from forgetting your next sked.

My Keyer Does It All

It is Monday morning about 6 a.m. and I'm sitting in my shack drinking coffee and trying to get my brain in gear for a CW sked I've got at 06:30. Suddenly I hear "DIT DAH DAH, DIT DAH DIT DIT, DAH DAH DAH." It's my CW station telling me it's time to turn on the radio and copy the weather from "WLO." The high-seas forecast is sent by WLO in CW at about 30 wpm and I'm copying it perfectly while glancing through the headlines in the day's paper. You probably think I am a real CW whiz to be able to do that while still half asleep, but I am not. I can only copy about 25 wpm on a good day with all my concentration. And I'm not using my computer either. I am using my keyer to copy and display the code! That's right, my *keyer*.

Actually, I call it the "N4UAU Super CW Station" because it is much more than a keyer or a clock. It also copies and displays CW from your receiver, sends random code (characters, words or callsigns) to practice, and displays it. And when you are ready to send CW, it becomes an iambic keyer, with three memories, that will display what you are sending. It is easy to build, fits in a small box 4" by 6", and costs only about $100 to build.

Project Features and Operation

The CW STATION does many different things. It:

- Copies and displays CW characters from your receiver.
- Calculates and displays the speed of the CW.
- Has an 80-character display mode that stores and displays the last 80 characters of code so you can review your copy and sending accuracy.
- Has a built-in random code generator. You set the character speed, space speed, group size and sidetone frequency. It will send random code in any of three different modes. The first mode sends characters. It lets you select only those exact characters you want to practice. The second mode sends 300 different common CW words. The third mode sends random callsigns. This feature will help you get ready for that CW test which always has at least two callsigns you will need to copy.
- Works as an iambic keyer (2 to 40 wpm).
- Has three message memories. You see the words you are storing in memory and can backspace to correct any errors.
- Displays all the CW characters on a 40-character by two-line LCD.
- Sets and displays all speeds digitally so you know the exact speed you are copying or sending.
- Has a built-in clock and calendar with an alarm.
- Has a built-in sidetone oscillator with an adjustable frequency (600 to 900 Hz).
- Has an on-board audio amplifier that can drive a small speaker.
- Uses a tuning LED to "zero beat" the other station.
- Allows easy external powering with the on-board voltage regulator.
- Can be used with an external key.
- Has battery backup to preserve all memory if a power failure occurs.

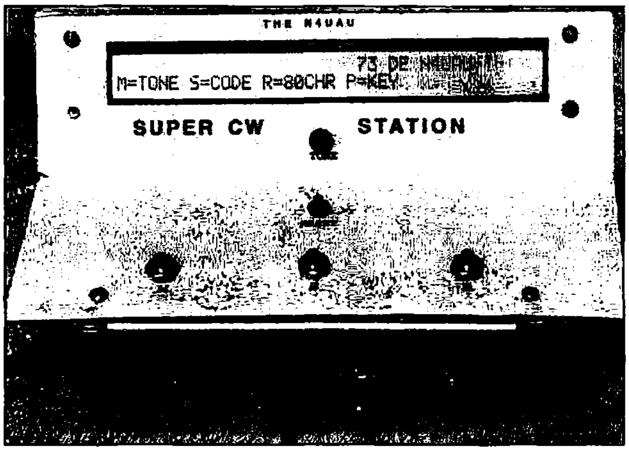


Photo A. The keyer's main menu.

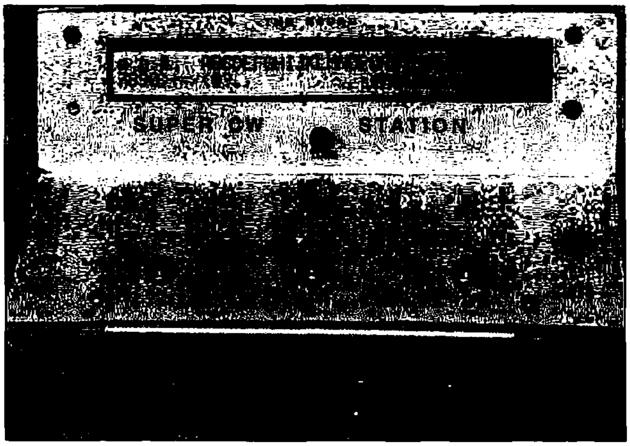


Photo B. The character menu.

The CW station uses only a few parts and is easily built because all the major parts are actually entire subcircuits in themselves. The heart of the project is the 87C52 microprocessor. It is a small process control computer with 8 kbytes of code that control the rest of the circuit. The 40-character by two-line LCD display has several processing circuits built into it that handle all the details of displaying the data. The LM567 decoder has circuitry built in to determine when a received signal is at the proper frequency and then demodulate it. The DS1202 is a time-keeping chip that has day of the week and leap year features.

All you need to do is solder

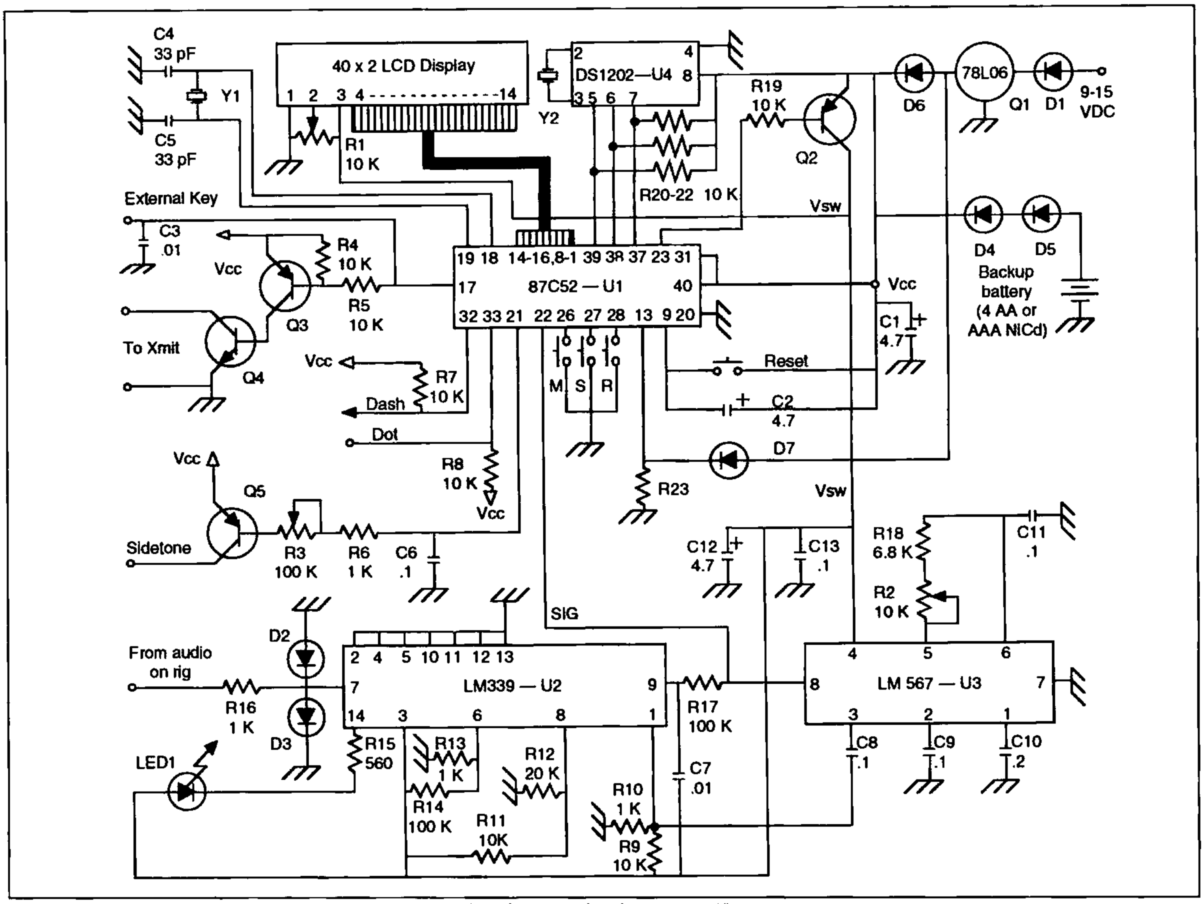


Figure 1. Schematic for the Super CW Station.

these parts together, set the display brightness to your liking, set the decoder to the frequency for your rig, and enjoy it!

Circuit Description

There are basically two sections to the CW station. The *microprocessor circuit* does all the processing in an 87C52. In it is an 8 kbyte program which the 11.0592 MHz crystal runs at a rate of about half a million instructions per second. When an incoming signal is received, the microprocessor measures the time of the element and determines whether it is a dot or a dash. This information is saved until an inter-character space is received. The microprocessor then determines what character was received by looking it up in a table, then that character is sent to the top line of the LCD display via 11 lines. The second line shows the speed of the code and the time of day. If you want to use the built-in iambic keyer function, the microprocessor will sample the paddle input lines and send the appropriate dots, dashes and corresponding spaces for that speed. It will also determine what character is being sent and display it on the LCD. The microprocessor sends the dots and dashes to pin 17, where they go to two transistors (Q3 and Q4) which can drive your transmitter.

Another signal is output at pin 21. This is a sidetone signal which goes to the audio amp (Q5). With the sidetone you can listen to your sending if you just want to practice and not actually transmit. The 10k pot (R1) is used to adjust the brightness of the LCD.

Four push-buttons are connected to the microprocessor. These are used to set speeds and control the various functions of the microprocessor. To prevent loss of clock or memory data, the circuit allows battery backup. When a power failure occurs, a signal is sent to the microprocessor at pin 13, causing the microprocessor to shut down all the circuits and put itself into a sleep mode. When power is restored, the keyer will wake up with all the data saved.

The *demodulator circuit* is the other part of the circuit. It decodes signals from your radio and sends them to the microprocessor. When a CW tone is heard on the speaker of your receiver, it is a series of dots and dashes that are modulated at around 750 hertz. In order for a computer to decode the tone it is necessary to make the signal either a high or low voltage level (5 volts or 0 volts). As with human CW operators, it is also necessary to filter out as much extraneous noise as possible so that a clean signal is available for copying. The demodulator helps do this with two IC chips.

The audio signal is brought into an LM339 quad comparator (U2) at pin 7. When the signal voltage is less than the voltage at pin 6 (set by R13 and R14), the output at pin 1 goes to ground. When the signal voltage is greater than the pin 6 voltage, 500 millivolts are applied to U3 because of the voltage divider formed by resistors R9 and R10.

U2 serves two purposes. First, it rejects noise levels that are not as strong as the desired signal. Second, it keeps the voltage to U3 independent of the signal strength. It is either 0 when no signal is recognized, or 500 millivolts if a signal is present. This is important for U3 to work properly. U3 is an LM567 designed to decode DTMF type signals and is basically a phase-locked loop. The lock frequency is set by R18, the 10k pot (R2) and C11.

C9 and C10 set the bandwidth. The maximum possible bandwidth of 14% of the center frequency (105 Hz at 750 Hz) is a pretty narrow filter, but it is ideal for our purpose. When the 500 millivolt signal from U2 is in the passband of the LM567, the output at pin 8 goes to 0 volts; otherwise, it is held at 5 volts by the 8752.

Tuning into a bandwidth of 100 Hz can be tricky. To make it easier, a second comparator on the LM339 is used to indicate when the sending station is in tune. The LED will flash the CW when it is tuned in; otherwise it will be off. Between looking at the LED and listening to the frequency of the code, you can tune in a station quickly and accurately.

Building the Project

With only a few parts and the PC board, this project is easy to build. There are a number of wires running from the PC board to switches and displays on the case. A careful layout will make the project neater. I have used a 4" by 6" aluminum case for my CW station and a Lexan top (see the photos). The aluminum box acts as a ground for all the jacks mounted to it, so I do not need to run a separate ground wire for each jack, thus reducing clutter.

The Lexan top protects the rather soft surface of the LCD display. Also, because it is easily heated and bent, I was able to set the LCD and LED at a better viewing angle. I used Lexan because it does not break, but Plexiglas works well, too, if you are careful. You can also use a plastic box, but you will need to run a ground wire to all the jacks. The current draw is about 30 milliamps (without the speaker) and you can power it from a 9- to 15-volt source. I have found a wall transformer to be a good power supply.

Using the CW Station

When you turn on the CW station, you will see the clock displayed. In this mode you can set the clock or alarm data, or you can enter the main menu by pressing the "M" button. In the main menu, "73 DE N4UAU" is displayed on the top line of the LCD. The second line shows: "M=TONE S=CODE R=80CHR P=KEY." You have the choice of going to one of several sub-menus, depending on what you want to do with your CW station:

1. Touch either the dot or dash paddle to use the CW station as a code translator and iambic keyer.
2. Press the "S" button to enter the random code generator.
3. Press the "R" button if you want to use the 80-character feature.
4. Press the "M" button to set the sidetone frequency.

Receiving and Sending CW

To copy incoming code, tune in a station. The tuning LED will be off until you tune it into the 100 Hz passband. When you see the LED flashing on and off with the Morse code, you are tuned in and you will see the received code scrolling across the top line of the LCD. The bottom line will show the speeds you set and the actual speed of the incoming code. The current time of day is also displayed on this line.

When you are in the receiving mode, you can send code just by touching your paddles or key. The receiver will stop copying the incoming code and will send and display your code. The code you are sending is displayed in capital letters to distinguish it from the received code, which is in small letters.

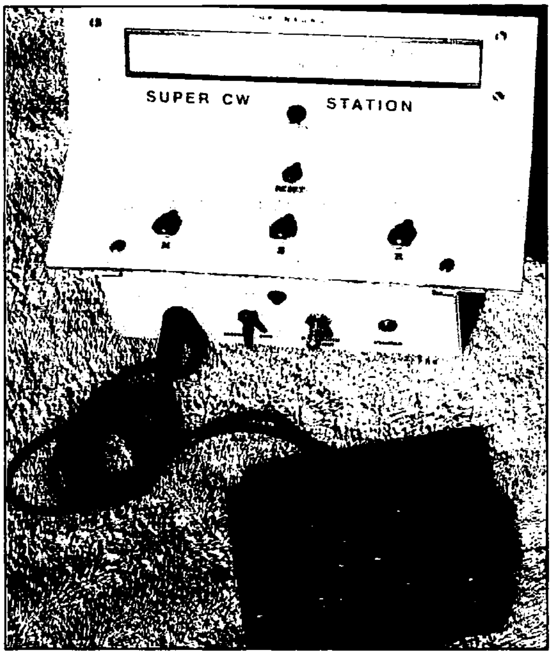


Photo C. The keyer connected to a paddle.

Electronic parts:

U1	87C52 preprogrammed micro
U2	LM339
U3	LM567
U4	DS1202
40 x 2 LCD display	
Q4	NPN transistor—2N4400
Q2,Q3,Q5	PNP transistor—2N3906
Y1	11.0592 MHz xtal
Y2	32.768 kHz xtal (6 pF)
Q1	78L06 voltage regulator
D2,D3,D4,D5,D7	1N4148 diode
D1,D6	1N4001 diode
R3	100k pot
R1,R2	10k pot
R14,R17	100k resistor
R4-5,R7-9,R11,R19-23	10k resistor
R18	6.8k resistor
R6,R10,R13,R16	1k resistor
R15	560 ohm resistor
R12	20 ohm resistor
C1,C2,C12	4.7 µF capacitor
C10	0.2 µF capacitor
C6,C8,C9,C11,C13	0.1 µF capacitor
C3,C7	0.01 µF capacitor
C4,C5	33 pF capacitor
For U1	40-pin socket
For U3,U4	8-pin socket
For U2	14-pin socket
PC board	
LED 1	LED—high intensity
M,S,R,RESET	N.O. push-button switches
Hook-up wire	
Parts for box shown:	
4" x 6" aluminum box	
1/8" Lexan, 5" x 8"	
Speaker	
12 VDC wall transformer	
Assorted hardware	

To change your sending speed, press the "S" button and use the dot and dash paddles to increase or decrease the speed (2 wpm to 40 wpm). When you stop sending, the keyer will shift back to the receiving mode.

The microprocessor calculates and displays the actual speed of the code it is processing by averaging the speed of the last 20 characters. It takes into consideration the element speed you set at the start, the number of blank spaces, and the characters being sent. The code display provides feedback on how good your sending is. If you are running characters together, you will see "&" rather than the letters you thought you sent. Increase your spacing a bit between the dots and dashes and you will see the letters.

You can use the keyer with an external key. However, you will need paddles to set speeds, etc. If you do not have paddles, a pair of push-button or microswitches can be used as a paddle to set speed. You can swap between using the internal and an external key any time you are in the receive mode.

When you first enter the keyer mode, the display will ask if you want to store a message. You can store three different messages. If you make a mistake when you are storing the message, just stop and press the "S" button. The cursor on the display will backspace and erase a letter at a time. When you have erased the error, just continue sending the message. You can send the message anytime you are using the keyer functions by pressing "M" and the appropriate memory location ("M," "S" or "R" button). The "R" message is also used by the alarm clock feature (see below).

The Random Code Generator

When you enter this mode you will see the first of three menus, the *speed menu*, which displays "CHAR=XX SPC=YY." You can set two speeds. The character speed sets how fast the elements are sent, and the space speed sets the spaces between characters and groups. This will let you send Farnsworth at any speed you want.

The next menu is the *mode and groups menu*. The mode can be set to "WRDS," "SIGN," or "CHRS." The WRD mode will send 300 common CW words and abbreviations. The SIGN mode sends callsigns. The U.S.-designated callsigns are used and suffix addenda are also sometimes added; i.e. /AG, /AA, /AE, /M, /2, etc. This allows you to get used to the callsigns most commonly used in exams.

In the CHRS mode, random characters are sent. You can set the character group size from 0 to 15. With the group set to 0 the keyer will send characters one at a time. Each time you press the dot paddle, the keyer will send and display the next character and then stop. If you want to hear the same character again, press the dash paddle. You can do this as often as you want until the sound of that character is familiar. To listen to a different character, press the dot paddle.

In the WRDS mode, the group size is used to set the way words are sent. Normally, words are sent to fill the LCD display and the Tutor stops so you can check your copy.

If you want to try practicing copying words in your head, you can set the group size to 0 or 1. The code generator will send random words continuously and they will scroll across the screen. You won't be able to write the words and check them, but if you want to learn to copy in your head this will give you good training.

The third menu is the *character menu*, which lets you select which characters you want to practice. It is only displayed if you select the CHRS mode. When it is first displayed, you will see all the possible characters. To select just some of the characters, use your paddles to "erase" the characters you do not want to copy, and leave the ones you do want to practice.

When you are ready to copy random code, the code will be sent and displayed on the LCD screen. When the screen is full, the Tutor will stop and let you compare your copy with what was sent. To send another set of 80 random characters, just press a paddle.

The 80-Character Mode

In this mode you can send or receive code but it will not scroll across the screen. Instead, it will fill up the 80 characters on the screen and stop. This feature is especially useful if you are copying code with pencil and paper, because it lets you concentrate on copying, and after 80 characters you can check your results. This mode is also helpful when you are practicing your sending, because it will let you concentrate on sending, and when the display is full you can check to see how well you sent.

Constant Tuning and Sidetone

This mode will let you send a continuous tone to the transmitter, and a sidetone signal. You can use this mode to tune your antenna or to change the frequency of the sidetone oscillator. The sidetone frequency can be set from 600 Hz to 900 Hz.

The Clock Mode

The clock mode displays the time, date and day of the week. In this mode, it also shows if the alarm is set. When the alarm is activated, the clock will send the message stored in memory "R." It sends it in CW on the sidetone speaker (but not to the transmitter!) and simultaneously displays it on the LCD. This message can be up to 15 characters in length. If you do not have a message in memory, the alarm just beeps.

Obtaining the Parts

Except for the 8752 and PC board, all parts are available from catalog parts suppliers like Digi-Key, Mouser, JDR, etc. The pre-programmed 87C52 and PC board are available from the author (5200 NW 43rd St., Suite 102-177, Gainesville, FL 32606; E-mail n4uau@freenet.ufl.edu) for $40. In addition, the author has a convenience pack of all the electronic parts for $85 and a limited number of box parts (aluminum box, pre-bent Lexan cover, speaker and wall transformer) for $15. Florida residents add sales tax please.

Collinear 5/8-Wave Omni Antenna for 2 Meters

Commercial antenna performance at a home-brew price!

by John Conklin WDØO

Ready to try your hand at building an omnidirectional gain antenna? This may be just the project for you! Using ordinary hand tools, you can construct this antenna in one evening from common hardware store materials.

dB or Not dB?

What does all this gain stuff mean . . . really? An electronic amplifier has an absolute limit to the amount of power it can produce, regardless of the input level. Accordingly, amplifiers are often rated in watts—an absolute term. Antennas on the other hand, have no maximum theoretical output power—what you get out of them depends on what you put into them. Therefore, antenna performance is rated in relative, rather than absolute, terms. Enter the decibel (dB). A decibel is one tenth of a bel, named for Alexander Graham Bell (hence the little d and capital B). Originally established to express changes in sound levels, the decibel is a term of relative power. A change of 1 dB in power level is just barely detectable by the human ear.

The correlation between the dB and power ratio is:

dB = 10 log (output power/input power)

A gain of 3 dB corresponds to a doubling of power. Thus, an antenna with a gain of 3 dB will have the same effect on your signal strength as if you had doubled output power. As an added bonus, the gain of an antenna applies to received signals as well.

Where does all this extra power come from? According to the first law of thermodynamics (conservation of energy), you can't get something for nothing. To create gain in any given direction, the power must be taken from some other direction. In the case of a beam, most of the RF is concentrated toward the front of the array and sacrificed at the sides and rear. An omnidirectional antenna, on the other hand, obtains its gain by reducing the amount of RF that is radiated upwards. Look at it this way: An omni antenna has a radiation pattern shaped like a doughnut. In order to increase its gain, the doughnut merely needs to be flattened, thus putting more signal out instead of up.

Gain must be expressed in relation to some standard for it to have any meaning. In antenna work, these values are usually ren-

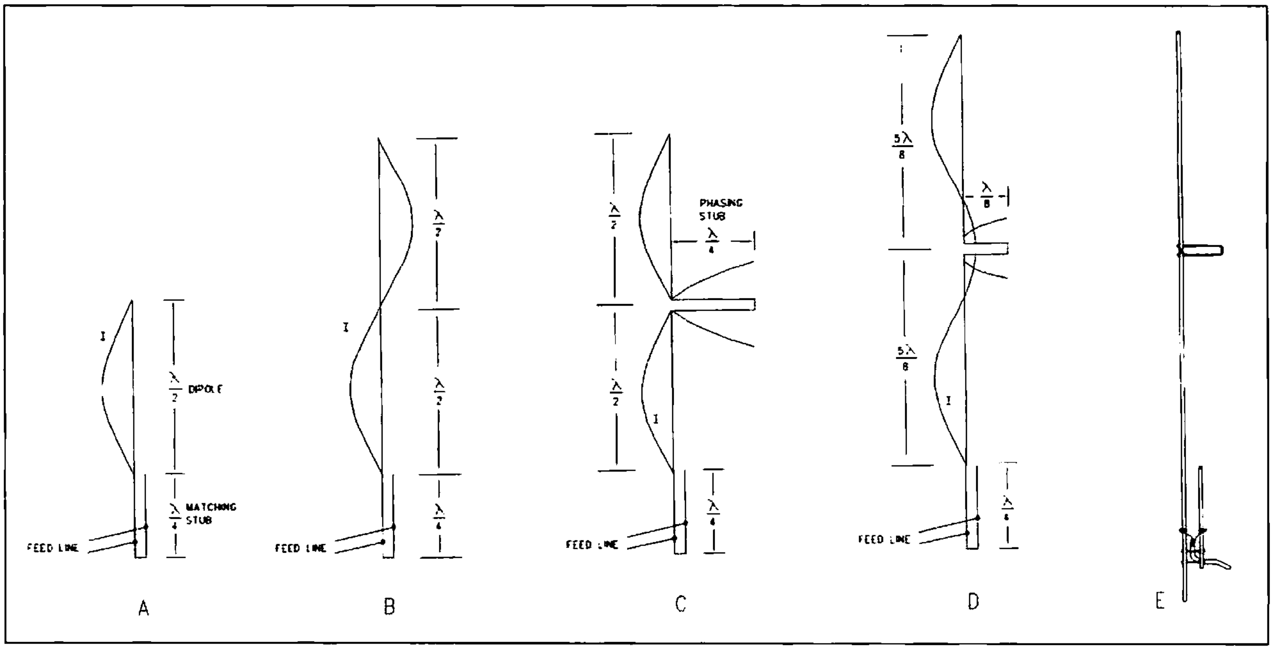


Figure 1. From dipole to deluxe. See this section of the text.

dered in terms of dBd (gain over a dipole). or less commonly, dBi (gain over isotropic). Since an isotropic radiator is a purely theoretical antenna, all measurements in this article are expressed in dBd. Incidentally, many manufacturers neglect to include any standard reference point in their advertising. There is no way of telling whether the purported gain is over a dipole, a ground plane, a dummy load or isotropic—even the venerable dipole has 2.1 dB gain over isotropic! It's wise to take advertised claims with a grain of salt.

From Dipole to Deluxe

An assortment of aluminium and hardware can double your effective radiated power. Here's how.

As you probably know, a half-wave dipole is customarily fed at the center. This is where the current is highest and the voltage is lowest, thus providing a nice, low impedance point for connecting 52-ohm coax. At the ends of the half-wave antenna just the opposite situation exists—the current is lowest, and the voltage is highest, constituting a very high impedance feed point.

Some sort of matching device must be used in order to overcome the impedance mismatch if an antenna is to be end-fed. The quarter-wave closed stub, a continuously variable impedance matching device, performs this function rather nicely. Think of it as a dipole folded in half. The impedance is very low at the closed end of the matching stub (center of the dipole), and very high at the open end of the stub (ends of the dipole). Connect the antenna to the open end and the feedline near the closed end (Figure 1A). The impedance can now be changed by simply moving the feed point up or down the stub. As an added advantage, the closed end of the matching stub may be grounded, thus placing the entire antenna at DC ground potential and simplifying mounting problems.

Now for some gain. If the length of the antenna is increased to two half-wavelengths, the antenna will exhibit only slight (0.5 dBd) gain. This is because the currents along each element are out of phase and cancel each other out (Figure 1B). However, if each of the two half-wave elements are fed in phase, the gain will be 1.9 dBd because the RF currents reinforce, rather than cancel, each other. In order to achieve this phasing, the signal must travel an extra half wavelength before arriving at the second element. The phasing stub is a half-wavelength conductor folded so that the sides are parallel and closely spaced (Figure 1C). RF currents along the stub are then equal in intensity but opposite in polarity, causing the currents to cancel and preventing the stub itself from radiating.

Antenna gain is further boosted to 3 dBd by increasing the spacing between elements. This is accomplished by lengthening the radiating elements to 5/8 wavelength and shortening the phasing stub by an equal amount (Figure 1D). The added length of antenna is out of phase, and causes some signal cancellation. However, since the current on the added length is small, and the section is short, the radiation is insignificant. Further lengthening of the elements will cause more cancellation, and the gain will actually decrease. The finished antenna is shown in Figure 1E.

Construction

Figure 2 illustrates the dimensions and layout of the antenna. Construction is straightforward and requires only the use of common hand tools. The majority of the antenna is made from 3/4" aluminium tubing, although any diameter from 1/2" to 1" should work fine.

Start by cutting the matching stub (23"), the lower radiating element (78-3/4"), and the upper radiating element (48-3/4") to length. Use a hacksaw to cut a 1-1/2"-long slit into the bottom end of the upper radiating element, and the top end of the lower radiating element. This will allow the tubing to clamp firmly around the insulator.

Next, drill the mounting holes in the matching stub and lower element. Position the top of the matching stub 48-3/4" down from the top of the lower radiating element and tape them together. This will keep them lined up while drilling the mounting holes. Make drilling marks on the matching stub 19" and 22" down from the top of the stub. Clamp the assembly in a vise (being careful not to crush the tubing) and drill through both pieces at the same time. Mount the matching stub to the lower radiating element with 3/16" galvanized washers, nuts and bolts (you'll need bolts that are threaded all the way to the head).

The insulator is a plastic or Fiberglas rod (obtainable at plastics supply houses) or wooden dowel waterproofed with either urethane or spar varnish. The insulator should be at least 9" long to provide good mechanical support between the two radiating elements and should be of a diameter that provides a snug fit inside the tubing. Slide the upper and lower elements over the insulator, leaving 1/2" exposed between sections.

Next, drill a phasing stub mounting hole in each element. The holes must be parallel and spaced 2" apart. The phasing stub is made from a 22" length of 10-24 threaded rod. Bend the center of the rod over a 2"-diameter pipe to produce a smooth bend. Then fasten the phasing stub to the antenna with 10-24 hardware. Stainless steel hose clamps are used to connect the coax to the matching stub, and the end of the coax is sealed with RTV sealant or electrical tape.

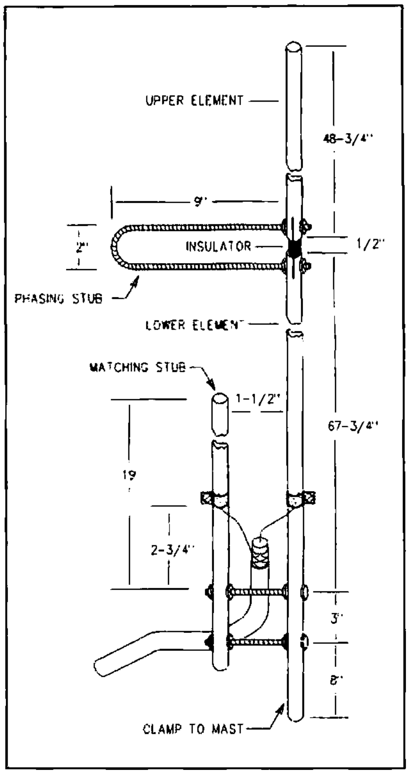


Figure 2. Construction details.

Adjustment

This antenna delivers good performance and has a respectable SWR curve over the entire 2 meter band. Tuning is accomplished by sliding the feed point (where the coax is clamped to the antenna) either up or down to secure the best match.

Bibliography

1988 *ARRL Antenna Book*.
1991 *ARRL Handbook*.
DeMaw, Doug, *W1FB's Antenna Notebook*, 1987.
Honeycutt, Richard A., *Popular Electronics*, August 1992, p. 65.

Parts List

Upper element	3/4" x 48-3/4" aluminum tubing
Lower element	3/4" x 78-3/4" aluminum tubing
Matching stub	3/4" x 23" aluminum tubing
Phasing stub	10-24 x 22" threaded galvanized rod
Insulator	Plastic, Fiberglas or wooden dowel, 9" long, diameter to fit tubing
4	10-24 nuts
4	#10 lock washers
2	3/16" x 3-1/2" bolts
6	3/16" nuts
6	3/16" lock washers
2	1" stainless steel hose clamps

Number 6 on your Feedback card

by Gordon West WB6NOA

SGC Inc.
SGC Building
13737 S.E. 26th St.
P.O. Box 3526
Bellevue WA 98009
Telephone: (206) 746-6310
(800) 259-7331
Fax (206) 746-6384
Price Class: $595

The SGC SG-230 Antenna Tuner

A longwire tuner for use on land or at sea.

Any idea what the initials "SGC" stand for? If you are an old-time ham or you got your start in amateur radio from Class D Citizens Band, you will recognize the name "Stoner" standing for the letter "S," and "Goral" standing for the "G," in SGC.

Don Stoner W6TNX pioneered premium-quality SSB CB transceivers in the early days of Class D Citizens Band, and Don's technical expertise in communications certainly owes him a spot in *Who's Who* when it comes to state-of-the-art radio designs. Don is now retired and living in Florida, and continues to take an active part in commercial and amateur radio technology.

Pierre Goral KI7UA, an active amateur operator, was the technical driving force behind SGC's development of made-in-the-USA communications products for the military, marine radio, land mobile radio, FEMA, CIA, FBI, and amateur radio services. Two-decade-old, crystal-type, marine SSB transceivers from SGC can still be found in operation, and Pierre and the entire gang at SGC, Inc., take great pride that their entire product line is designed, manufactured, and marketed right out of their Bellevue, Washington, facility in the Pacific Northwest.

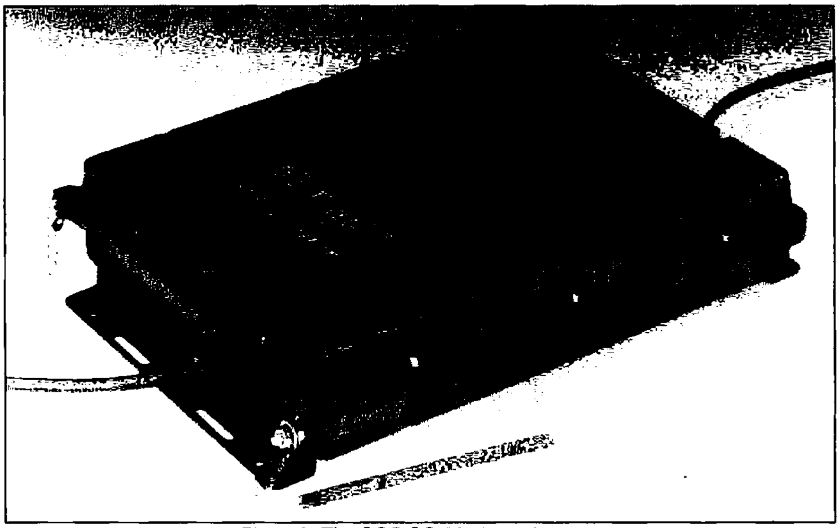


Photo A. The SGC SG-230 longwire tuner.

The History

The SGC Model SG-230 automatic antenna coupler originally started out as a marine ATU (automatic tuning unit) to complement the many models of marine and military SGC 100-watt output SSB transceivers. The SG-230 automatic antenna tuner (also called an automatic antenna coupler) came out at about the same time Stephen Engineering Corporation came out with the SEA-1612 antenna coupler, Hull Engineering introduced a marine Model 402, and Motorola brought out their own brand and style of marine antenna coupler. But SEA and SGC were unique in the fact that their own couplers did not require a data line from a specific transceiver to switch the unit into active tuning and then lock it on tune for a specific frequency. Both the SEA and SGC couplers would tune any length of wire from 2 MHz to 30 MHz from any type of transceiver when the coupler would detect RF power input at the SO-239 jack inside the coupler.

Here at the Gordon West Radio School, we quickly saw the possibilities of an automatic antenna coupler serving the needs of amateur operators *ashore* who wanted to resonate a longwire or loop antenna system remotely, so the tuning point was well away from the operating position, minimizing RF energy coming off of the longwire and getting back into the SSB transceiver. SEA expressed no interest in marketing their automatic antenna tuner through amateur radio distribution, and local marine radio dealers who were carrying the SEA-1612 automatic coupler had no intention of two-stepping the product into the amateur radio service. Even offers of 50- and 100-unit orders to SEA were declined, to protect the marine electronic dealers who were successfully selling this tuner at approximately $999 as a marine-only SSB automatic tuner.

When Pierre at SGC saw the potential of the SG-230 tuner for not only marine but also land applications, he was quick to establish amateur radio distribution. He now indicates that land and mobile use of the SG-230 is equal to the use of this tuner for many different types of marine SSB transceivers, and amateur land and military use are outgrowing the marine use as more and more mariners opt for satellite communications, rather than SSB stations, for ship-to-shore messaging.

"The proposed low-earth-orbit cellular-phone-like service for mariners may cause a decrease in the amount of SSB systems we put aboard large boats," comments Bill Alber WA6CAX, a marine electronics Installer from San Francisco. "SSB marine radio with these antenna tuning units will continue as the 'intercom band' among mariners, but we see some boats going exclusively with satellite communications, where it might be actually easier to call the Coast Guard on satellite distress frequencies than to rely on Mother Nature for ionospheric skip calls," adds Alber. "And lately, most of my automatic antenna installations have been on land at ham radio installations," finalizes Alber.

Automatic Tuners—Big Differences

High frequency amateur radio SSB transceivers which cover 160 meters through 10 meters may indeed offer a built-in, microprocessor-controlled automatic antenna tuner.

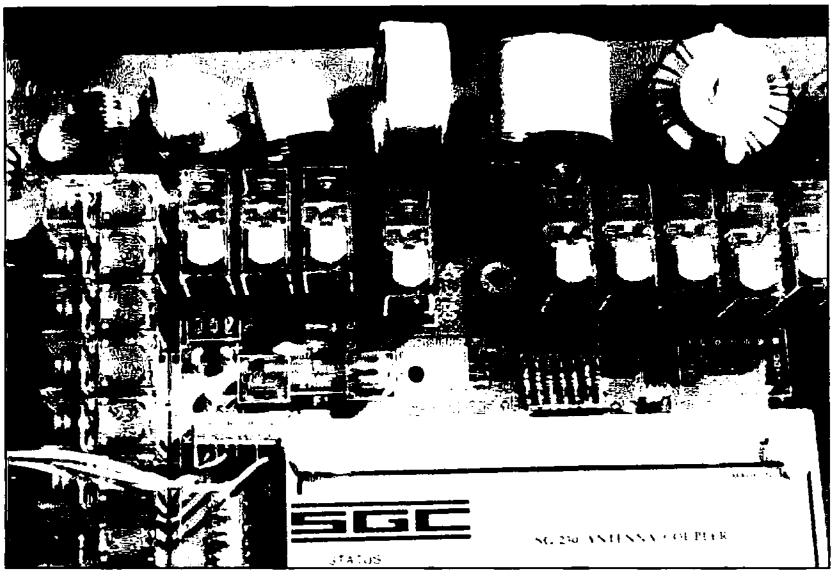


Photo B. These relays switch in various values of inductance and capacitance to resonate the tuner.

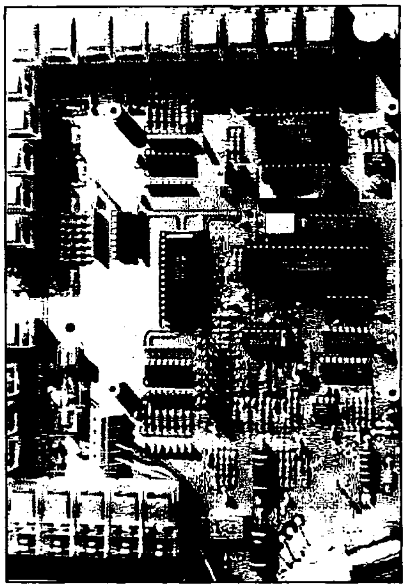


Photo C. The SGC coupler is microprocessor-driven, with active relays for minimum power loss.

The amateur radio built-in ATU (antenna tuner unit) outputs its capability to the standard SO-239 50-ohm coax antenna jack. And it's at the back of your transceiver that the ham HF set with a built-in tuner creates, most of the time, the feed point of your signal. This means the tuning process takes place right at the ham set, and what comes out of the back of the ham set is actively tuned coax up to your antenna system on the roof or on the side of your power boat, or on the stern of your sailboat, or on the top of your motor home.

The built-in HF automatic antenna tuner is specifically designed for resonant antenna systems. The built-in HF antenna tuner works superbly in fine-tuning beam antennas, multiband dipoles, and resonant dipoles when you need to operate a couple of hundred kilohertz off of the natural resonant point.

The built-in HF antenna tuner is *not* designed to tune random wire antennas or nonresonant dipoles, and will rarely offer tuning capabilities to the typical marine installation of insulated random-wire backstays or nonresonant SSB whip antennas. In fact, most HF instruction manuals caution not to use the tuner when the antenna's "natural" SWR is above 4:1 to 1.

"The tuner goes up in smoke," comments one technician at a leading HF manufacturer who sees ATU failures when the user tries to tune up a random wire or non-resonant dipole. "Sometimes the built-in tuner will simply hunt, and then switch out of circuit, indicating no match. Other times, the tuner will sense a low SWR point, lock on, and the 100 watts output travels up the coax, bounces off of a non-resonant longwire, and back down the coax and onto the chassis of the equipment. Ultimately, the RF gets into the transceiver, and zap ..." comments the repair technician.

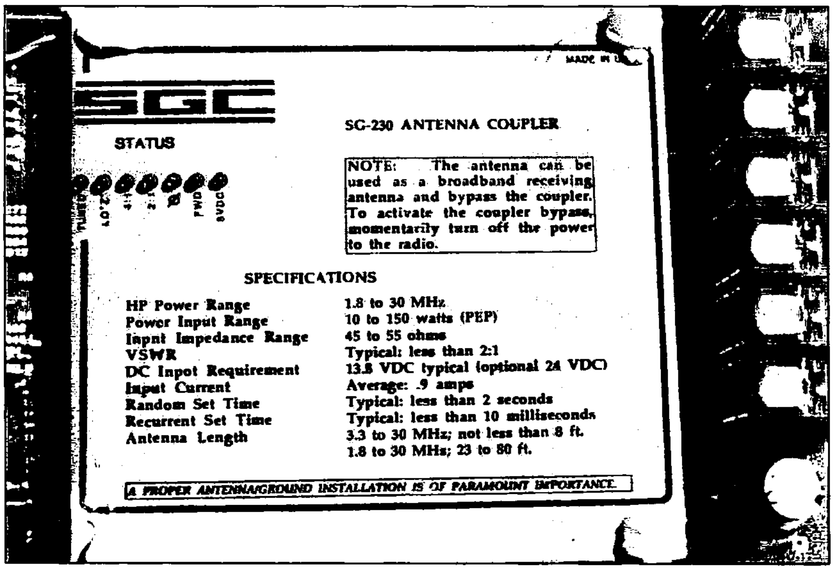


Photo D. Status LEDs on the inside of the tuner confirm that everything is working properly.

So use your built-in automatic HF antenna tuner for the purpose it was designed for—reducing slightly elevated SWRs when operating outside of the natural resonance of the antenna by a few hundred kilohertz. Even though the tuner may have locked onto a low SWR point on your antenna and coax system, you could be tuning up the outside chassis of your equipment and the braid of the coax as part of the entire antenna system at your shack. And you might even be getting out on the airwaves—but chances are that the longwire is not getting all of the power that it could receive from an external antenna tuner specifically designed for longwire applications.

The SGC automatic antenna tuner is specifically designed for remote mounting away from your HF amateur transceiver. In a boat, the automatic tuner goes back aft in a sailboat mooring line locker (called the lazarette), or up on the flying bridge underside to feed a non-resonant white Fiberglas whip. In mobile homes, hams have found that the SGC tuner should go in the back, up high, to feed a longwire along the roof. In homes and offices, the SGC tuner goes up at the roof line. "The automatic antenna tuner is specifically designed for use with end-fed, unbalanced antennas, such as whips and longwires," comments Pierre Goral KI7UA. "Antenna efficiency will be proportional to length, and this means that the longest possible antenna wire should be selected for the lowest frequency you plan to operate on," adds Goral. He points out that shortwires are only recommended when there is no other alterna-

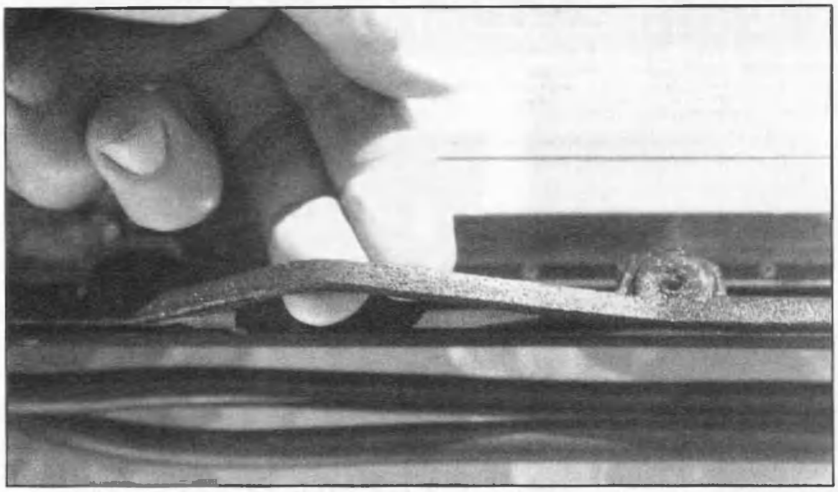


Photo E. The waterproof housing uses a gooey rubber gasket to seal out rain.

tive. such as in a vehicle mobile installation.

Part of the overall antenna system is the ground that is brought up to the base of the tuner, and for marine installations this is usually accomplished with low-inductance copper foil. In home installations and offices, the ground must be attached to chicken wire holding on stucco, or any major metal source on top of an office. In airplanes, it's the fuselage. Out on Field Day, the ground could be a nearby stream or ground foil entrenched out from the tuner an inch under the earth.

In other words, the feed point now becomes the antenna tuner itself, not right at the HF SSB ham or marine transceiver that you are sitting in front of. Not only does this minimize splash-back by the outgoing RF, but it also keeps your equipment from sounding distorted when high SWR on the line from built-in automatic tuners creeps into your microphone circuit. Won't happen with the SG-230—it creates a 50-ohm match at the feed point, and this lets the coax run "cold" from your rig to the remote-mounted tuner.

The factory only puts on 10 feet of coax with the tuner, and this is truly too short for most home, office, field, or marine installations. You will need to add additional coax, plus an additional four-conductor line that supplies 12 volts and tune-indicator/tune-freeze capabilities. I recommend using a barrel connection and RG-213 to extend the coax line. Below 30 MHz, this connection (kept bone dry) won't amount to any significant dB loss. You are probably thinking it would be better to run the RG-213 directly into the tuner box to replace what's already provided, but if you try that, you break the weather-tight seal on the tuner, and you then quickly find out that it's a hard-wire connection that would be difficult to accomplish easily with bigger coax. Use the coax jumper and weatherproof the connection point, and save yourself from grief!

The four-conductor line that is part of the original SGC coax assembly has a red and black wire for 12 volts. Sixteen-gauge is fine as an extension because the tuner only consumes about 900 milliamps during active tuning, and half that when it is locked on. The actual current will vary slightly, because the microprocessor may have few, some, or many of the relays engaged. I don't think I have ever seen an SGC pull more than 1 amp.

The other two white wires with color tracers are for an accessory "in-tune" LED, as well as an accessory tune lock capability designed primarily for mobile installations. The remote-tuned indicator line goes low to ground when the SG-230 is tuned. This means you hang a diode off of the red wire to the white wire with a black tracer, to illuminate when the tuner has found an optimum tuning. I don't use the LED—I just look at my transceiver, and when I see the power indicator go all the way over to 100 watts output, I know that the tuner has achieved "tuned." If the tuner isn't tuned, the modern HF amateur transceiver will show next to nothing for power output, and this is an indication that you forgot to turn on the 12 volts that lets the tuner do its thing.

The other white wire with a red tracer is for an accessory "SmartLock" controller that is sometimes necessary to keep the tuner locked on when tuning a non-resonant whip in a mobile installation. On lower ham bands, the tuner is constantly seeing a varying impedance on the whip as it swings around on the vehicle, and this lock-up feature freezes the tuner when the best match has been found with the whip relatively motionless. But since we don't recommend a short antenna being remotely tuned with this tuner for mobile installations, you won't need to worry about this extra wire.

Indeed, SGC makes this tuner for mobile units, but you'll get "zip" performance if trying to tune a stainless steel mobile whip with the tuner in your trunk. You would do better to run pre-tuned whips and keep the tuner out of line. The tuner is not designed for tuning anything normally fed with coax cable. In fact, trying to run coax on the tuner output will lead to a no-tune situation because of the high capacitance shunt to ground. "Every foot of coax represents 29 picofarads, and 29 picofarads to ground can represent a large loss," explains Goral. About the only type of whip that could work with the SGC coupler is the very special high-current helical whip Model 303 that SGC offers with the mobile SGC quick-mount system. This puts the tuner into a big metal box that hangs on the side of a vehicle, and the whip from SGC (Model 303) protrudes out of the mount and stands about nine feet tall. It's a relatively good-performing system, but only an amateur operator could appreciate what it looks like on the side of a new car.

Typical Installations

To calculate how much coax and two-conductor power lead you might need, consider the following "typical" amateur radio installations.

Tuner back aft in a sailboat, feeding an insulated backstay antenna: The separation is 15 to 30 feet, and you'll need about 50 feet of copper foil to complete the ground connection. You will need about 15 feet of GTO15 high-voltage single wire with plastic insulation to feed the output of the insulated portion of the backstay.

Home installation with a tuner in the attic: This could be 20 feet to 75 feet away and up. Plastic-coated, stranded copper wire is the radiator, typically run along the horizontal beam in an attic. The tuner is mounted to the side of the house wall, and picks up chicken wire for a good counterpoise ground to the earth.

Tuner mounted on top of an industrial building—up to 150 feet away using Belden-style 9913 coax for the extra long run: Use 14-gauge for the extra long power run. Single wire 60 to 300 feet long runs in the clear on the top of the roof. Keep it away from metals, and make sure it's plastic-coated to ensure

Photo F. Author Gordon West WB6NOA sets up an SGC coupler high atop a hotel in Mexico.

Photo G. The auto-tuner QMS-mounted on an off-the-road vehicle.

that it doesn't arc over to anything metal. The tuner grounds to metal flashing on the roof, or to anything "major metal" on the top of the roof.

Tuner mounted on metal ham radio tower: Short braid grounds the tuner to the tower as a counterpoise. The longwire from the tower goes over to a big tree 60 feet away, and then goes to other growing things on your property. Use insulated wire. You wouldn't think of running it over to your neighbor's tree, would you?

An installation challenge—no ground on top of a wood office building: No problem—run 6 to 8 turns around the office with 16-gauge or larger wire. Start with the high-voltage antenna output, and terminate to the tuner's own ground. This loop antenna represents a DC short circuit, but works great on HF. It has very low noise. Make sure the radio is well grounded to keep the mike from biting you.

Recreational vehicle, tuner mounted up high along the roof line: Plastic-coated wire on 18-inch PVC standoffs run around the Fiberglas roof. The tuner grounds to a metal chassis with foil or braid. For metal-roofed mobile homes, try this and see how it works. You may do better to take the longwire and throw it over a nearby tree when you're out camping.

Using the automatic tuner like a dipole: Use random-length wire going one way from the antenna post, and random-length wire coming off the ground post going in the opposite direction. Make sure the radio is well grounded in this installation.

Tuning up a flagpole set in concrete: If you can find or initiate an installation where the aluminum flagpole is isolated from the metal structures inside the concrete, all the better. The tuner hides at the base. Single wire goes to the flagpole, and foil attaches to a suitable ground plane in the concrete. For safety, insulate the metal portion of the flagpole where anyone might touch it accidentally, or dogs could water it. Fly Old Glory with a nylon pulley, and be patriotic while working HF.

In the SGC tuner manual, they give additional tips on how to run the automatic coupler for interesting results. Experiment, experiment, experiment!

How It Works

When you apply 12 volts DC, the insides of the antenna tuner snap to attention with an audible click. The tuner uses super-quality relays to engage various amounts of inductance and capacitance to resonate the antenna system. Everyone worries that the relays will go bad in the marine environment, but their gold-plated contacts and their operation have proven reliable, with relay failure being almost zero on the technician fix-it reports.

The tuner receives its command to begin the tune-up process by your simply speaking into the microphone on your SSB transceiver without the need to push any transceiver buttons, or the need to switch to CW or AM. Simply say, "FFFFF OOOOO UUUUU RRRRR" for about two seconds, and that's it. Do it on the highest frequency desired, and then the lowest frequency desired, and listen for a clattering of the PC-mounted relays. As the SGC automatic coupler begins its tune-up process, it begins to learn your antenna's requirements and stores this information in a chip memory system that is capable of memorizing hundreds of individual frequency/relay combinations—very useful when operating on 40 meters, 75 meters, and 160 meters, where a slight change in frequency will necessitate new values of L and C to be relay-switched into the circuit.

A detector device in the SG-230 monitors the antenna system impedance, reactance signal, and the VSWR load when you say "FFFFF OOOOO UUUUU RRRRR" into the mike. The computer inside the tuner uses the spoken word to detect power across six capacitors in shunt on the input arm of the network, arranged in binary increments; eight inductors in the series arm, arranged in binary increments; and five more capacitors in shunt on the output arm. Relays are provided in conjunction with each lumped constant and allow removal or entry as desired. A network having 64 values of input shunt C, 32 values of output shunt C, and up to 256 values of series L is possible with the internal 26 relays (C for capacitance, and L for inductance).

A tune-up algorithm which is contained in the memory of the computer system inside the SGC actually implements the antenna matching. The computer is designed around the C-Moss MC146805E2 CPU which features a versatile instruction set and an on-chip timer and RAM. The antenna coupler relays are controlled through IC9, a MM5480 decode/driver. The MM5480 is used as a serial-to-parallel interface port, and the clock and data inputs of the MM5480 are driven from CPU ports PA1 and PA0, respectively.

The tuner monitors the status of the input sensors and, starting from a preset condition baseline, manipulates the RF elements L and C through its control algorithm, resulting in a correctly tuned condition. When tuned, your radio sees 50 ohms, for maximum power output. The typical tune process takes about 20 milliseconds once the tuner has recognized a specific length of antenna wire and a suitable ground. If the wire and ground system remain unchanged, the tuner won't go through the one- or two-second "clatter" search.

While the optional light-emitting diode circuit may illuminate an LED that the tuner has found tuned, you can easily tell by monitoring the output power of your transceiver when you say the magic word "FFFFF OOOOO UUUUU RRRRR." As you speak into the microphone in your QSO, your power output will continue to register full. Whether you view power output on your transceiver as colored LEDs, or as a meter movement, there is no mistaking that the tuner is radiating the signal and giving your set a thumbs-up 50-ohm load.

For shortwave listening on the general coverage high frequency band, you can tune the tuner to the 30 meter ham band and enjoy great reception from 4 MHz to 18 MHz, going through the pre-tuned settings. If you want to bypass the tuner settings, simply remove the 12 volts, then turn it back on, and the tuning elements remain out of the circuit until the tuner is activated by your transmit signal.

There are jumpers inside the tuner that could drop the tuning elements out of the circuit for receive, but I recommend leaving these jumpers alone and not breaking open the tuner case. Unless you're operating in a frequency-hopping scheme, use the tuner straight out of the box as it comes from the factory.

And how well does it work? Aboard boats, better than mobile whips on a stainless steel rail in establishing contacts beyond 2,500 miles. Within 2,500 miles, both mobile whips and the tuner work fabulously. In most home installations and office buildings, an extremely long wire will do as good as, if not better than, pre-cut dipoles. Just be sure to keep the active antenna element as far away from noisemakers as possible. For home installations, watch out for TVI, too. Since the wire is so long and so hot with RF, it can easily get into home electronics when it's draped over a roof line.

Will the longwire work better than a beam? Hardly. Maybe for close-in, high-angle radiation contacts, but nothing beats a beam. Will it work better than a roof-mounted trap vertical? Very comparable, but without the sight of a big, tall vertical on the roof. Will it work mobile with an extremely short CB-type whip? Hardly. For mobile applications, SGC has a special model and a special whip.

Will the tuner work better than solid-state toroidal inductive matching networks? Infinitely so! I don't need to tell you what's inside those passive antenna networks sold for hundreds of dollars. Ask the X-ray machine at *QST!*

Out here in Southern California where antenna restrictions are common in new housing developments, the SGC automatic antenna coupler is an effective way of putting out a powerful signal from an antenna system that will go unnoticed by your neighbors.

The SGC Model SG-230 antenna tuner carries a marine retail price around $600, but can be seen selling in the amateur radio market new for approximately $450. If you are looking for something fun to play with this summer, the SGC Model SG-230 antenna tuner is a real RF workhorse.

Features

2 MHz to 30 MHz continuous operation
150 maximum watts input SSB
Input impedance—45 to 55 ohms
Input VSWR after tune-out—less than 2:1
DC requirement—13.8 VEC
Input current—900 miliamps
Antenna length recommendations—25 feet to 100 feet, 3.5-30 MHz; 50 feet to 200 feet, 1.8-30 MHz
Installation—any position
Size—16" x 12" x 3"
Weight—8 pounds
Case—ABS weatherproof plastic
Control cable—9 feet coax and 4 power/tune wires
Instruction manual—included; first half non-technical, second half very technical, available for $10, refundable with factory purchase of tuner
Distribution—dealers or direct for export
Technical service support—excellent; write or call the factory.
Amateur operator feedback on SGC technical assistance and repair—overwhelmingly positive comments when repair or technical advice was needed. Easily reached by phone, with immediate follow-up always.

Number 7 on your Feedback card

by Peter R. James WM4U

Advanced Electronic Applications
P.O. Box C2160
Lynnwood WA 98036
Telephone: (800) 432-8873
Price Class: $199

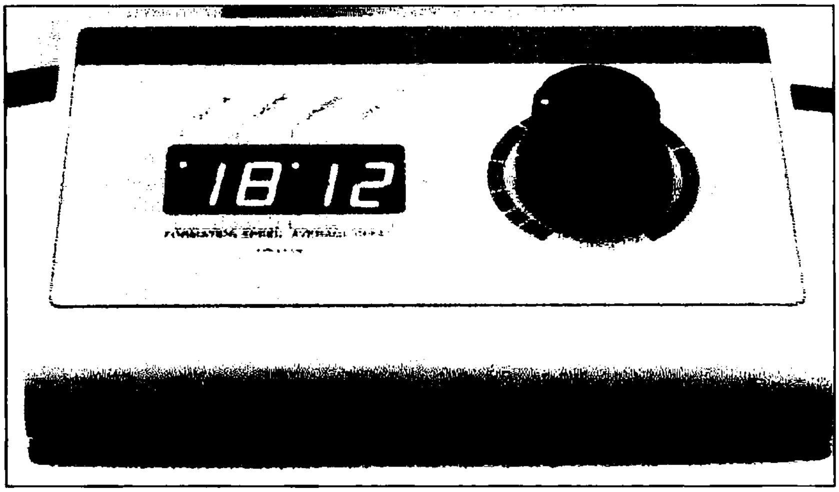
The KK-1 from AEA

The perfect keyer.

Have you ever had the perfect ham accessory and then lost it somehow, never to find it again?

I think that each of us has, at some time, had the most wonderful ham-related item and then sold it, traded it, or broke it, losing it forever. In my case, the perfect CW keyer crossed my path about 10 years ago in the form of the Heathkit CW keyboard. It performed flawlessly. With a large type-ahead buffer, soft sectored memories, and the easiest operation possible, it became a good friend until, in a fit of poor judgement, I sold it.

I didn't see one again until I ran into the new AEA KK-1 keyboard. I say this because the new AEA keyboard was designed by Terry Perdue K8TP, the same engineer who designed the Heath keyer. The similarities are profound. There is no doubt about the family lines: 255-character type-ahead buffer, soft sectored memories, small number of function switches, etc. So I was very happy to discover the new nephew of my old friend and promptly acquired one.



The KK-1 keyer from AEA.

The KK-1

The newest product from Advanced Electronic Applications comes in a small, 173mm x 114mm x 64mm, package that needs only an AT-style keyboard and a 12 VDC power supply. The keyboard can do double duty with your station computer. This was a design element in engineering the keyer, as the unit comes with a cable to connect your PC keyboard to both the computer and the keyer. Using a simple keystroke, you can switch from CW keyboard to your computer logging program, or whatever program you routinely leave running on the shack computer. The 12 VDC can be supplied from a simple plug-in brick, your shack supply, or even a battery.

The only apparent control is a large knob that is used to set the sidetone or the keyer speed. The speed is more easily controlled by keyboard entry, however. And speaking of speed control, this unit is the only one I know of that lets you use any combination of keying speed and spacing. Using this feature, you can set it up to use Farnsworth keying or any combination that suits your fancy. By using the shift key and the arrow keys you can set the speed and spacing while watching the digital readout. This green display is the only other thing on the front panel other than the knob. By the way, the keyer is shaped like a long wedge, giving you an attractive sloped front and a large rear panel that has all of the connectors necessary for hooking up the keyer.

The rear panel has a power supply connector, keyboard input and output (to connect to your computer), paddle input, outputs for normal keying or grid-block keying, an on/off switch, a headphone connector, and volume control. Use a 1/4" phone plug to plug in your favorite iambic key. At any time while you are operating you can change over to manual keying just by using your key. If you are not handy at typing, this may be a great feature for you. For the slow typist, you can, at your leisure, type in all the data you want, assign message ports, and then in a QSO switch over to manual keying.

The Memories

The memory is almost 8K and can be divided up into 12 message centers. You can even link one message to another. You can tell one memory to switch to another at a certain time in the keying sequence. The programming only allows one level of nesting, but this shouldn't be much of a problem to the average user. The keyer also allows you to send serial numbers for those contests that use that system of exchange. Eight K doesn't sound like much memory until you try filling it up. It really is a lot of memory for the average ham.

The memories are set up using the function keys on the keyboard. With a typical AT board you have 12 F-keys, and thus 12 separate memories. A typical station setup would put a CQ sequence in one memory, "your RST is" in another, and then your QTH, etc., in another. I use the last two functions keys for identification purposes. One sends "de WM4U K" while the other sends just my call.

Using the Keyboard

This is a very fancy memory keyer, but one using the keyboard as an input device, allowing you to send perfect code every time. Using a keyboard makes it very easy to operate CW and gives those on the receiving end perfect copy on their multimode controllers.

Now why should you go with a dedicated keyboard instead of using a multimode unit? The biggest reason is simplicity. You don't need to have a video display or to know any

complicated operating sequences. This also frees up your computer for use as a dedicated packet DX cluster monitor, logger, etc., but still leaves you with perfect CW at your fingertips with no program changing.

I've been using my keyboard for over a month with no problems whatsoever execpt for two things (always a catch, eh?). One small complaint is that the unit produces a small amount of computer hash, most noticably *on* the bottom end of 20 meters. The last memory keyer I owned produced so much noise it made 20 meter CW nearly impossible, but this unit has minimum noise in comparison.

The other quirk I have encountered is in the choice of keyboards. I bought a new keyboard at the same time I purchased the keyer, and for a long time I noticed no problem until I got on 80 meter CW. At this point I was ready to toss the keyer out the door. It locked up at times, sent random CW with no input, sent crazy things from the memories, and was just plain useless. Turns out the problem is not with the keyer but with the keyboard I bought. It is very, very susceptible to RF on 80 meters. I tried two other keyboards and found that my old Tandy keyboard would take any amount of RF and keep on doing its thing with no problems at all. However, the new keyboard would not work on the computer. Now, on to my other computer, which is a Magnavox 386. That keyboard would not operate the keyer. It would send just four characters, and four only. So much for the AT-style keyboard being a random selection item. You'd better check out your keyboard with the unit before settling on it as a permanent investment.

Specifications

Character formation 5-90 wpm
Sending speed range 5 wpm to formation speed
12 memories
Keying output positive to ground and grid-block
Serial numbers 1-9999
Message auto-repeat delay 1-99 seconds
Dot-dash ratio (weighting) Normal plus 9 light and 9 heavy settings
255-character type-ahead buffer
Message capacity 7913 characters
Sidetone range 200-2500 Hz
Power requirement 10-16 VDC at 350 mA

KKCOM for Easy Programming

For those of you who want an even easier way to program your KK-1 keyer, AEA now has a software/hardware package to facilitate loading the memory buffers. Called *KKCOM*, the package consists of software supplied on both 3.50" and 5.25" floppies, and what at first appears to be a simple cable with a 1/4" stereo plug on one and and a 25-pin computer connector on the other. However, inside the 25-pin connector is a small circuit board with 10 components on it: four transistors, five resistors, and a diode. This circuit forms an interface between your computer and the KK-1 keyer. The 25-pin connector goes to your serial port, and the stereo plug goes into the keyer where the paddles normally connect.

The software makes it possible to display what you are typing into the 12 memory buffers. These message centers can then be uploaded Into the KK-1 keyer with the proper command. The current contents of your keyer memories can also be downloaded Into your computer for storage and/or modification. In addition to memory management, you can also change your keyer speed, sidetone, spacing, etc., from your computer.

To use the KKCOM system your KK-1 must have version 2 or later firmware. AEA has certainly been busy making ongoing improvements with their keyer, as they have been changing the firmware faster than most of us change (your choice of cliche here).

The current retail price of the KKCOM is $49 and it comes with complete documentation, interface, cable, and stereo plug. If you want to update your KK-1 keyer from version 1 to version 3 it will cost approximately $75; from version 2 to version 3, $65.

Other Features

Other features of the KK-1 are 19 settings for weighting, auto-repeat delay, adjustable sidetone, and CW practice. Unlike its little brother, the MM-3, this keyer can't carry on conversations with you. However, we're on the simplicity of operation bandwagon and this certainly fits the bill. There are certain keys on the keyboard that do special functions such as send CQ or "de," or send procedural signs such as KN and SK with a single keystroke, plus TUNE. One item that would be very useful would be an overlay with these keys marked. Perhaps that will be an item for the entrepreneurs to come up with.

The keyer is warrantied for one year and has a suggested retail price of $199.

Its simplicity of operation and the dependability of AEA products in general make this a keyboard keyer that will fill a niche in the shack. I'm definitely not going to sell this one!

Battery Monitor and Charger Controller

by Marion D. Kitchens K4GOK

Many hams have a 12-volt automobile battery under the operating table for a variety of uses. There is a continuing need to know the battery voltage and to keep it charged. A hassle-free means of solving these two problems is offered by the battery monitor and charger controller described in this article.

This unit displays the battery voltage on a 10-segment bar LED in increments of 0.5 volts over the range of 10.0 to 14.5 volts. When the battery voltage drops to 12.0 volts the unit automatically enables the 110 VAC line to the charger and begins charging the battery. As the battery voltage rises to 14.0 volts, the unit disables the 110 VAC line, turning off the charger. A discrete LED provides a visual indication of the on-off state of the charger. The 110 VAC line control is all solid state, eliminating mechanical relays and the inevitable pitting and dirty relay contacts. The circuit automatically switches to the "Charge" condition upon application of 12 VDC to the unit.

A printed circuit board layout is provided (see Figures 2 and 3) for builders who desire to make their own. Etched and drilled boards are available from FAR Circuits (see the Parts List) as well. The circuit is simple enough to be easily built on perf board, as a prototype was. It is easy to build and has no tricky circuits or difficult adjustments. All components are readily available at most of the mail order supply houses such as Digi-Key, or from "Peg Board" sources such as JimPaks. The unit is configured to occupy minimal shelf space on a crowded operating table, while presenting the display for easy visibility and power connections near the rear of the table. This results in the long, narrow configuration shown in the photos.

The Circuit

The schematic for the battery monitor and charger controller is shown in Figure 1. The circuit senses the 12V battery voltage and applies it to the input of the LM3914. The LM3914 converts the analog input voltage to 10 discrete outputs, each of which drives a segment of the bar LED. The LM3914 in this unit is wired as an expanded-scale voltmeter so that the first LED lights when the input is 10.0 volts and the last LED lights when the input is 14.5 volts. Thus, the various LEDs light following the battery voltage as it discharges and is recharged. The bar LED provides the battery voltage monitoring function.

The 4011B quad gate is wired as a set-reset flip-flop. The "set" input is connected to the "12.0V" LED pin of the LM3914, so that the 4011B output is set high when the 12.0V LED lights. The "reset" input is similarly connected to the "14.0V" LED pin of the LM3914. When the battery voltage reaches 14.0 volts the 4011B output is reset low. The 4011B output drives the MOC 3010 optoisolator, turning it on and off as the battery voltage ranges between 12.0 and 14.0 volts. The MOC 3010 in turn operates the triac, which switches the 110 VAC on and off to the battery charger. Two gates of the 4011B are wired to control a discrete "charge" indicator LED, in an identical set-reset manner. Note that the 4011B has inputs and outputs wired

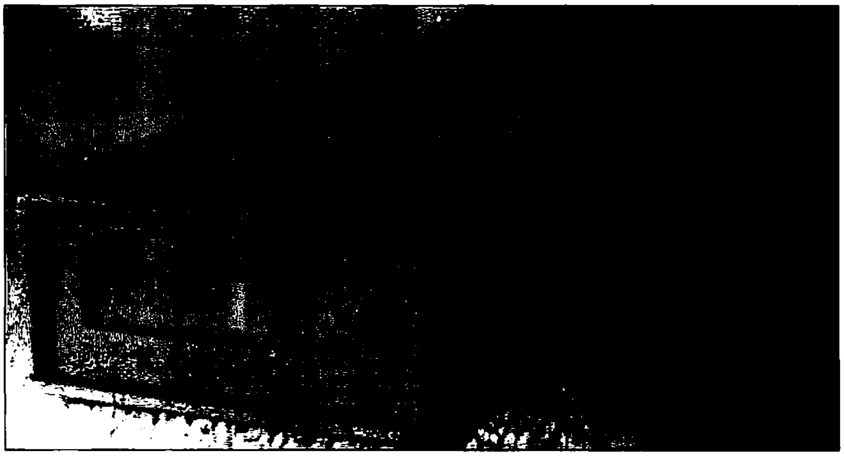


Photo A. Completed battery monitor and charge controller unit.

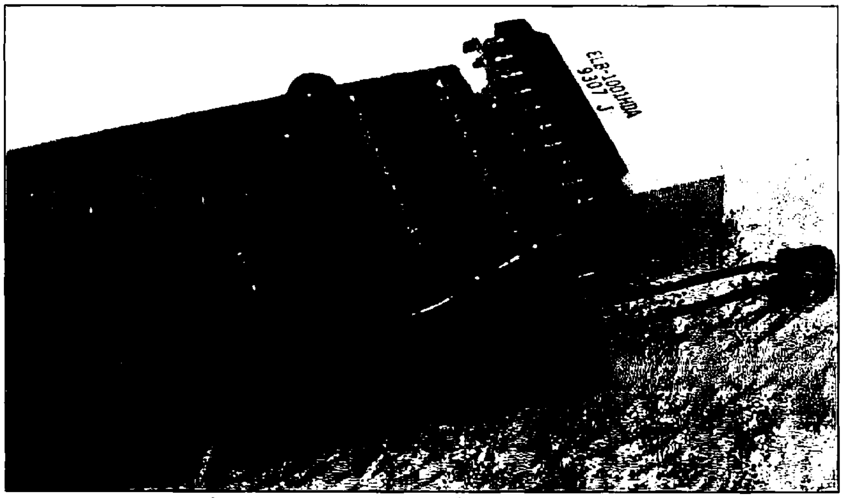
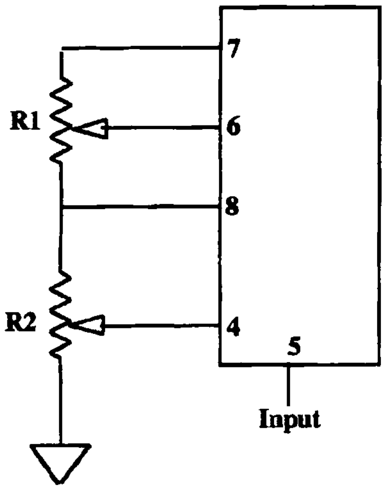


Photo B. Bar LED and 560-ohm resistor mounting.

Design Equations And Principles For The LM3914, 15, & 16 Chips

Reference Circuit 1



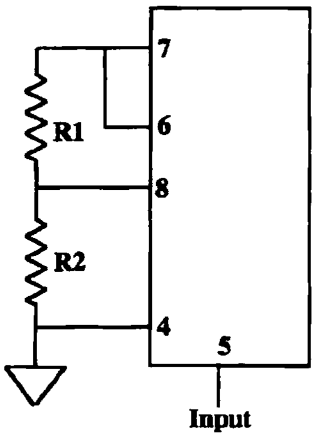
Principles:

1. The chip maintains a constant 1.25V across pins 7 and 8.
2. The current thru each LED is determined by the resistance between pins 7 and 8.
   Current =12.5/R1
3. Current thru R2 is the same (close) as R1.
4. Pin 6 is the top of an internal precision resistor chain, and pin 4 is the low end. This chain is connected to the internal comparators, and is compared with the voltage at pin 5 for determining which LED to light.
5. The #10 LED lights when pin 5 voltage is that on pin 6. The #0 LED lights when pin 5 voltage is that on pin 4.

Design Notes:

1. The voltage across R1 is always 1.25 $\pm$.03
2. The voltage across R2 is always...
   V_{R2}= (R2/R1)(1.25)
3. The sum of voltage across R1 and R2 can't exceed the supply voltage, naturally!
4. Maximum voltage at pin 6 (wiper at top) is V_{R1}+ V_{R2}
5. Minimum voltage at pin 6 (wiper at bottom) is V_{R2}
6. Maximun voltage at pin 4 is V_{R2}
7. Minimum voltage at pin 4 is zero (ground).
8. Chip to chip variations cause minor voltage variations

Reference Circuit 2



Design Example - Circuit 1

R1 = 1.0K, R2 = 5.0K
LED current = 12.5/1.0K = 12.5 ma
Max V_4 = (5.0/1.0)(1.25) = 6.25 volts
Min V_6 = 6.25 volts (same as above)
Max V_6 = 6.25 + 1.25 = 7.50 volts

Design Example - Circuit 2

Zero to 5 Volt Meter (V_6 = 5.0, V_4 = 0.0)
LED Current = 10ma
R1 = 12.5/.010 = 1.25K
V_{R2} = 5.0-1.25 = 3.75
R2 = (3.75)(1.25)/1.25K = 3.75K

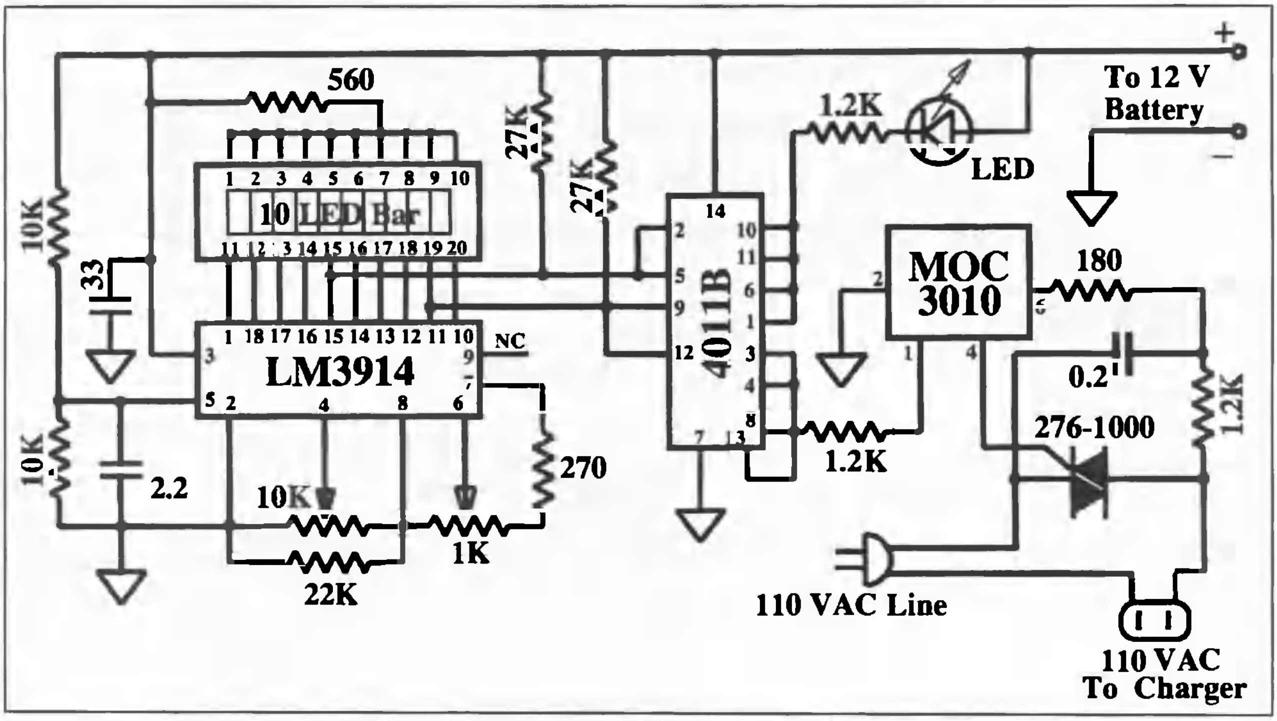


Figure 1. Battery monitor and charge controller schematic.

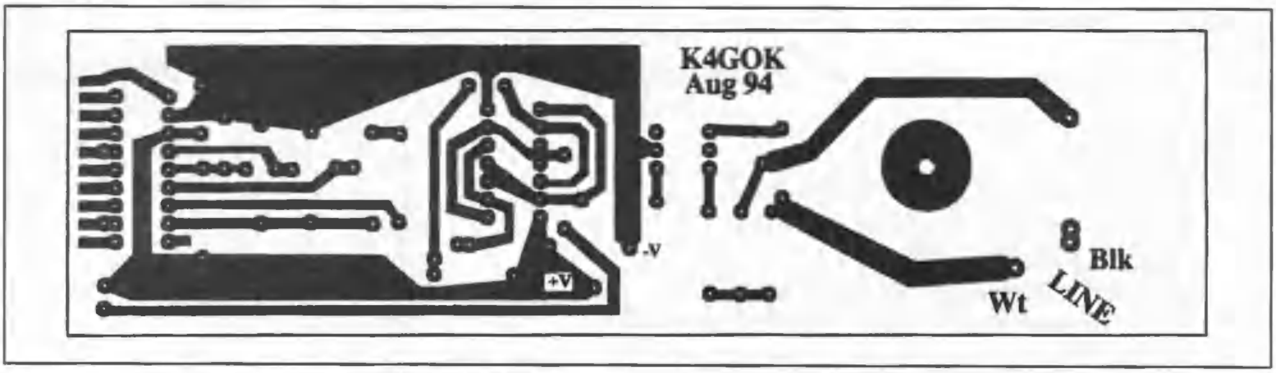


Figure 2. PCB foil pattern (view from copper foil side).

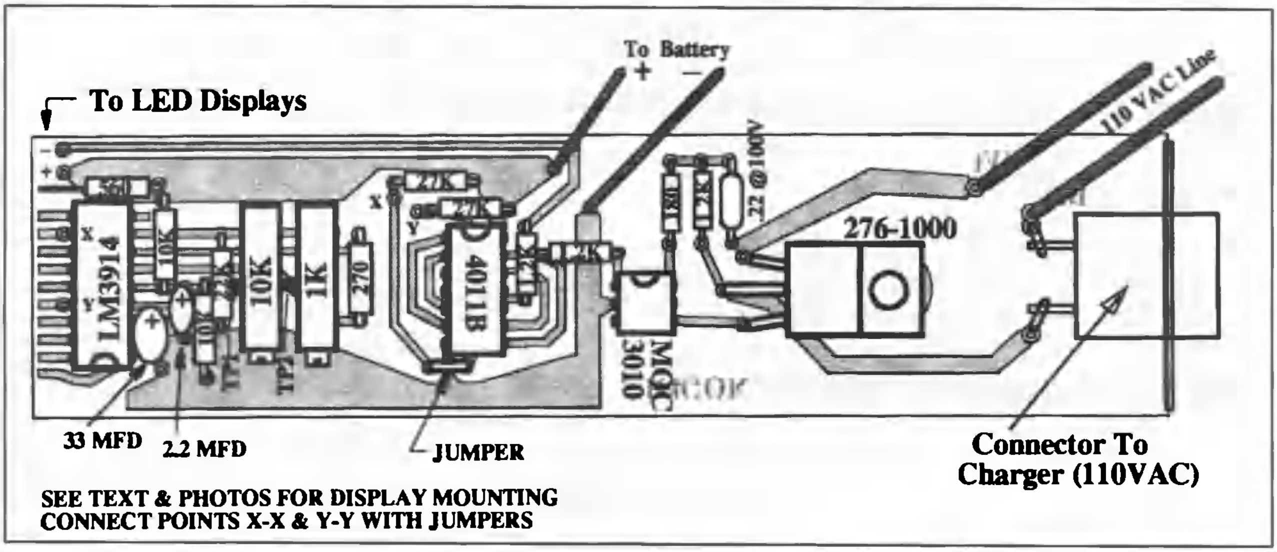


Figure 3. Parts placement drawing.

in parallel to provide the necessary drive to the other circuit elements.

Construction and Checkout

Construction is rather straightforward when using the PCB. The PCB foil pattern is shown in Figure 2. Install all the IC sockets, resistors and caps as shown on the parts placement drawing, Figure 3, except for the 560-ohm resistor. Sockets are recommended for all of the ICs except the triac, which should be soldered in place. Bolt the triac to the PCB for good thermal conduction. Observe proper polarity when installing the 2.2 and 33 MFD tant caps. Note that there are three jumpers on this PCB. One is near pin 7 of the 4011B and is installed from the component side of the board. The other two are installed on the foil side of the board, and go between the points marked Y-Y and X-X, as shown on the parts placement drawing.

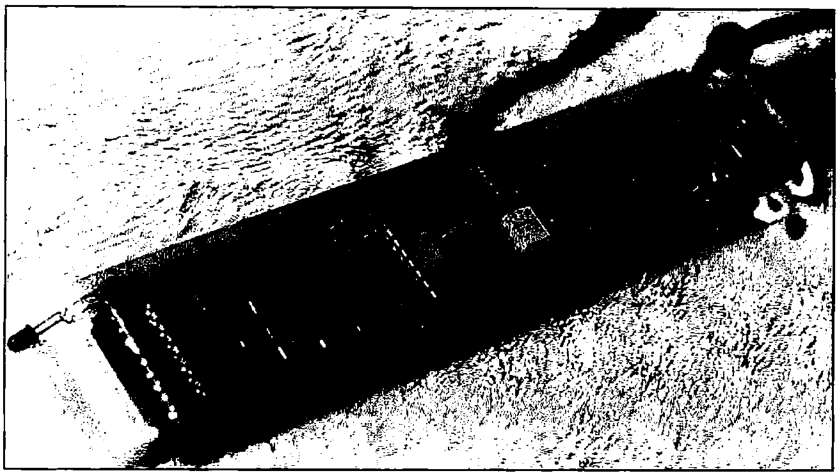


Photo C. Completed circuit board.

The LEDs should be installed next. A socket for the 10-segment bar LED is recommended. Note that the bar LED socket is mounted 90 degrees to the PCB surface. Solder the socket directly to the edge of the PCB. The resistor lead should be soldered to all the socket pins along one edge, as shown. Study the photo to see how the socket and the 560-ohm resistor are mounted. Solder in place the "charge" LED with lead lengths so that it will extend through the front panel.

At this point the PCB should be carefully inspected for solder bridges. Check that all points that should be connected to 12V are, and that everything that should be connected to ground is. Verify that there is no short between 12V and ground. Be careful checking this circuit because potentially dangerous voltages will be present before checkout is completed. Make sure no 110 VAC is connected for the moment. Remove any voltage on the two caps by temporarily shorting across them at the cap leads. Connect an ohmmeter between test point 1 and ground, and adjust the 10k pot for a reading of 4.9k. Adjust the 1k pot for an ohmmeter reading of 7.2k between test point 2 and ground. Pay careful attention to the proper orientation of the ICs and install them. Briefly apply 12 VDC power and verify that the "charge" LED lights. One segment of the bar LED should also light at this time.

Next power the PCB with a variable voltage DC supply that will cover the range from 9 to 15 volts. Set the power supply at about 12 VDC. Adjust the 10k pot for 4.90 volts at test point 1 (TP1), then adjust the 1k pot for 7.25 volts at TP2. Set the power supply to 14.5 volts output, and fine-tune the 1k pot so that the "14.5V" LED just lights. The "14.5V" LED will be the rightmost one when the PCB is component-side-down. Then set the power supply to 10.0V and fine-trim the 10k pot so that the "10.0V" LED just lights (the leftmost LED with the PCB upside down). Repeat these adjustments until the "14.5V" LED lights just as the supply voltage rises to 14.5 volts, and that the "10.0V" LED lights just as the supply voltage falls to 10.0 volts. Note that there may be some interaction between these two adjustments.

During the above calibration, the "charge" LED should light when the voltage falls to 12.0 volts, and should go off when the voltage rises to 14.5. It is necessary to apply 110 VAC to make the next checks. Use appropriate caution. Connect your charger or a 110V low-wattage light bulb to the unit. Connect the unit to the 110 VAC line. Vary the DC power supply voltage and verify that the charger or lamp come on and go off at 12.0 and 14.0 volts, respectively. Remove the 110 VAC and check for heating of the components. Nothing in this unit should be hot after operating for several minutes. *Do not* check for temperature effects with 110 VAC applied to the unit.

This completes checkout of the unit. It is ready for mounting in a small container. A container can be made from copper-clad PCB material. It is important that the PCB be mounted in the container with the components downward for proper reading of the LED display. The "charge" LED will be on the right when the board is properly mounted. Figure 4 shows how the battery monitor and charger controller are connected to the battery and charger. Note that the 12V battery connections for the monitor and charger controller should be connected directly to the battery terminals as shown. The sidebar on page 33 contains design principles and equations for readers who might want to apply the LM3914 in other applications.

Conclusion

The battery monitor and charger controller has been in use at this QTH for many months. It serves its intended purpose well. The automobile battery under the operating table stays charged automatically, and battery voltage is obvious at a glance. Others are encouraged to build a duplicate unit and enjoy the hassle-free benefits it provides.

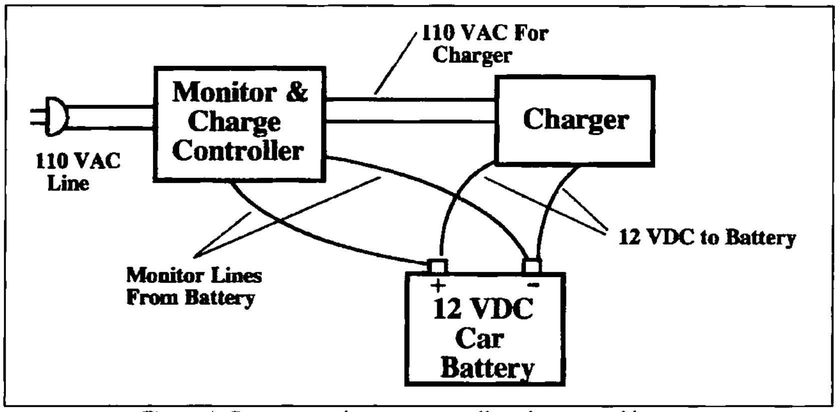


Figure 4. Connections between controller, charger and battery.

Parts List

Resistors
1 each 270, 560, 820, 22k
2 each 10k, 27k
3 each 1.2k
1 each Pot 1k, 10k

Capacitors
1 each 0.1 @ 200V
1 each 2.2, 30 µF @25V

ICs
1 each LM3914, 4011B, MOC3010, RS276-1000

LEDs
1 each 10-segment bar LED, mini LED

Misc. connectors, sockets, etc.

PCB available from FAR Circuits, 18N640 Field Court, Dundee IL 60118 ($6.25 plus $1.50 S&H per order).

An Inexpensive Morse Code Keyer

Build your own for under 10 bucks.

by Tony Marchese N2YMW

A friend of mine recently convinced me to take the examination for an amateur radio license. I had previously considered obtaining a license but was less than thrilled with the prospect of learning Morse code. I argued that I was as dumb as a stump when it came to memorization but was assured that learning code was not as tough as it seemed.

I realized that the best way for me to learn Morse code was to actually generate the sounds. I perused the various amateur radio publications in search of a CW practice oscillator. I found several in the $30 range but, being a frugal individual (a.k.a. cheapskate), I opted to construct an oscillator of my own design based upon the following parameters:

1. Automatic formation of the dit/dah length relationship followed with a "space." The relationship between the dit, dah, and space, according to the *ARRL Handbook*, is defined in terms of unit length with a dah three times longer in duration than either the dit or space. A paddle set was used in place of a straight key to accommodate this feature.
2. Memory—holding one paddle "down" repeats the tone with the appropriate spacing inserted in between. Holding both paddles "down" alternates between dit and dah with a space inserted between tones.
3. Variable character speed to allow for advancement.
4. Total project cost of less than $10. All ICs and components were to be standard, readily available items, as I have rarely had luck locating those neat, obscure components that are used in some designs. Fortunately, I have a box (OK, several boxes) of recycled circuit boards and parts, to which my wife affectionately refers as "junk."
5. Long battery life to last through the countless hours of practice.
6. Adjustable sidetone oscillator.
7. The ability to connect the device to a transmitter.

Theory of Operation

I computed the acceptable frequency ranges for both the adjustable sidetone and character length oscillators as an initial design step. The oscillators were constructed using gates C, D, E, and F of U1, a CD4049 CMOS hex inverter with: Frequency = 1/(2.2 RC). The sidetone oscillator uses a resistance which varies from 6.8k ohm through 16.8k ohm, and a 0.047 µF capacitor to generate a frequency which adjusts from approximately 550 Hz to 1400 Hz. This accommodates the typical sidetone frequency range of 800 to 1200 Hz.

The unit length oscillator incorporates a resistance which varies from 3.3k ohm to 13.3k ohm, and a capacitance of 2.0 µF to create an adjustable 17 to 69 hertz oscillator. This oscillator provides the clock for U4, a CD4017 CMOS decade counter. The state of the U5 multiplexer A0 and A1 lines selects the main timing clock from either the 2, 4, 6, or 8 output of the decade counter, depending on whether a dit, dah, or space is under production. This configuration provides a consistent unit length relationship which is independent of frequency or oscillator drift. The use of the even outputs divides the clock by 2, resulting in a unit length frequency of 8.5 to 34.5 Hz. As the *ARRL Handbook* equates code speed, in words per minute (wpm), to the Frequency x 1.2, the oscillator produces a continuously variable 10-41 wpm character rate.

The "tone" cycle is initiated by depressing either the DIT or DAH paddle. Activating the DIT paddle places a high on the K input to the U3A flip-flop. The J input to the flip-flop is low, provided the DAH paddle is not also depressed. With the inhibit line to pin 6 of the U2B NOR gate low, the transition caused by depression of the DIT paddle clocks the U3A flip-flop, causing the Q output to toggle low. Since the J input of the U3B flip-flop is high and the K input is low, clocking the gate with the same pulse sets the Q output high, thereby temporarily inhibiting any further paddle clock pulses. The NOT Q output toggles low at this time, enabling the decade counter, the multiplexer, and the U6B BCD counter, which turns on the Q1 transmitter key transistor. The multiplexer's Y0x inputs now selected as A0 and A1 are both low. The DIT tone is created as the sidetone oscillator present on the multiplexer's Y0A input is passed through output ZA to the speaker.

After two unit length oscillator cycles, the equivalent of a DIT, the decade counter's Q2 output sets high. This high is gated through the multiplexer's ZB output, which clocks the U6A BCD counter, setting the Q0 output high. The Q0 output resets the U6B BCD counter to turn off the transmitter key transistor. The Q0 output also drives the multiplexer's input select line A0 high to now select the Y1x inputs. This silences the sidetone as Y1A is grounded and selects the decade counter's Q4 output as the new source for the U5A BCD counter enable clock. The decade counter's Q4 output requires two additional unit length oscillator cycles, the equivalent of a SPACE, before setting high to clock the U6A BCD counter. Clocking the U6A BCD counter sets the Q1 output high. This clears the U3B flip-flop to disable both the decade counter and the multiplexer while releasing the paddle clock inhibit line, pin 6 of U2B, and resetting the U6A BCD counter. The memory function utilizes the U2B NOR gate to generate a clock pulse and initiate a tone cycle if either paddle is depressed during the release of the paddle clock inhibit line. If both paddles are depressed, the U3A flip-flop Q output toggles states, thereby alternating between DIT and DAH tones. The keyer is now ready to generate the next tone.

The operation of the DAH paddle is similar, except the U3A flip-flop Q output toggles high. This selects the decade counter Q6 output, which requires three times as many clock cycles as the use of Q2, and in doing so sets up the appropriate DIT/DAH length relationship. The decade counter Q8 output functions as the SPACE interval, identical in operation to the use of Q4, described in the previous section.

The final stage of the circuit is comprised of transistor Q2 which, in conjunction with resistors R11, R12, and R13, forms an adjustable gain amplifier for control of the sidetone volume.

Construction

The complete circuit, illustrated in the schematic shown in Figure 1, uses six standard 4000-series CMOS ICs in the design.

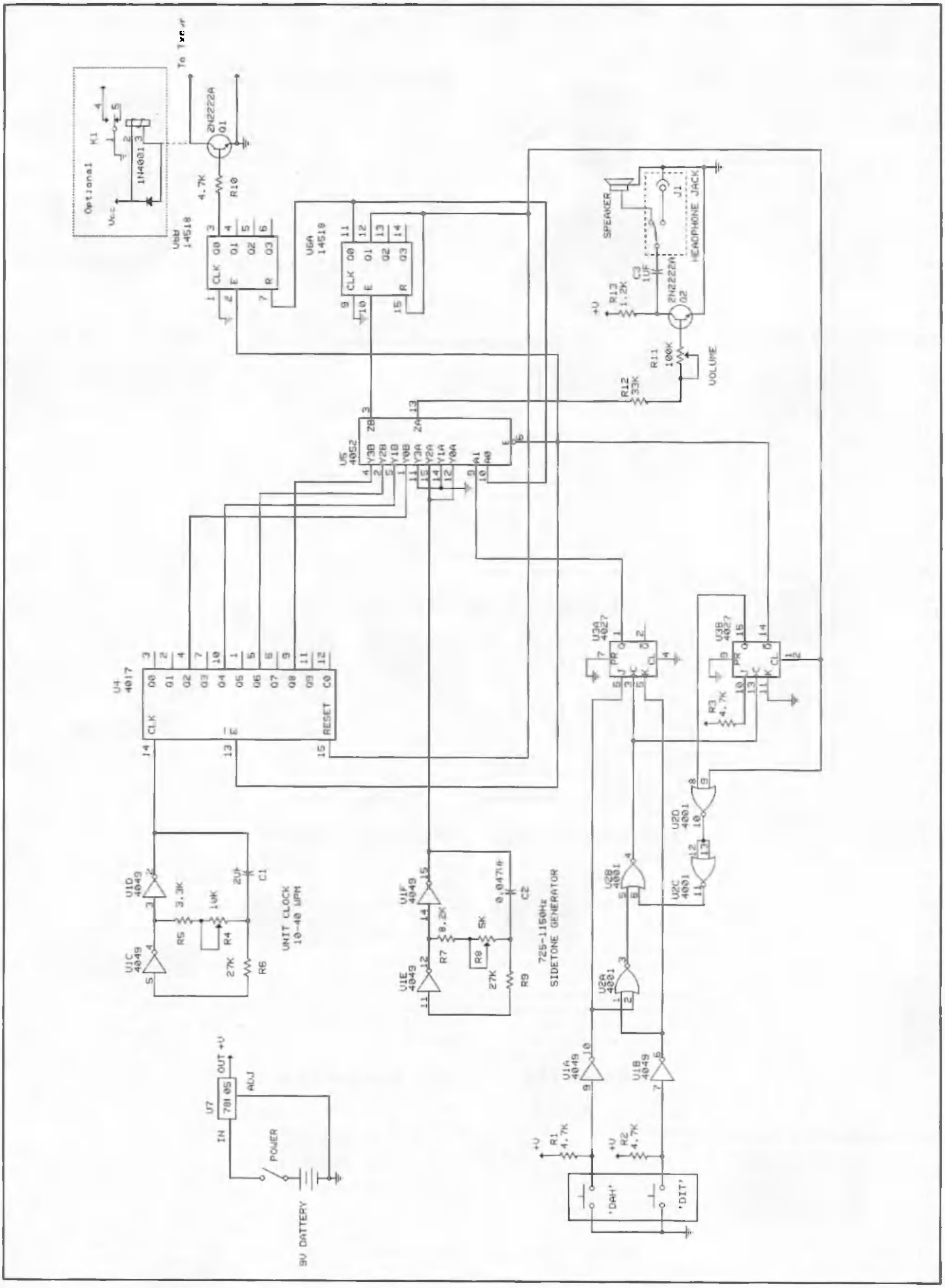


Figure 1. Keyer schematic.

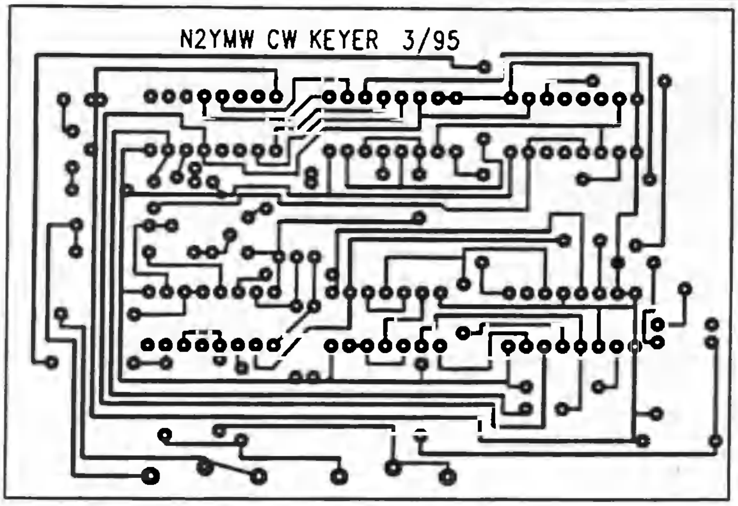


Figure 2. Printed circuit board artwork.

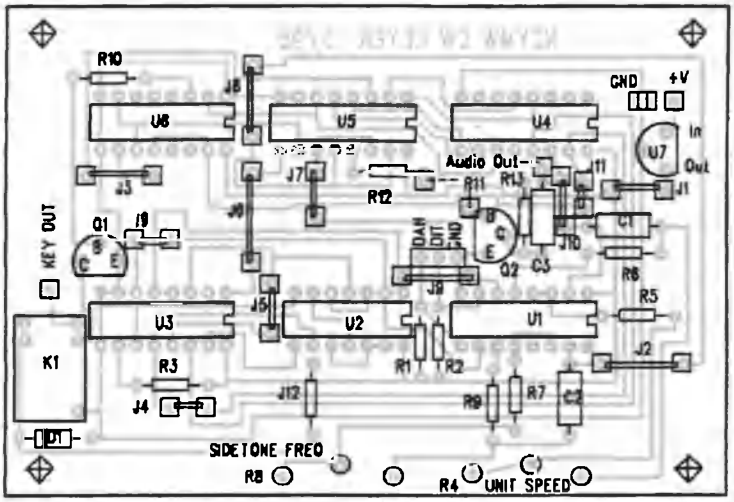


Figure 3. Printed circuit board parts layout.

Parts List

All of the required parts were obtained by mail order for less than $10.

U1	4049	Hex inverter/buffer
U2	4001	Quad two-input NOR gate
U3	4027	Dual JK, set/clear flip-flop
U4	4017	Decade counter
U5	4052	Dual four-channel analog multiplexer/demultiplexer
U6	14518	Dual BCD up counter
U7	78L05	5V regulator
J1-J11		Jumper wires
Q1	2N2222	NPN transistor
R1, R2, R3, R104.		7k resistor, 1/4 watt
R4, R8		10k potentiometer
R5		3.3k resistor, 1/4 watt
R6, R9		27k resistor, 1/4 watt
R7		6.8k resistor, 1/4 watt
R12		33k resistor, 1/4 watt
R13		1.2k resistor, 1/4 watt
C1		2.0 µF capacitor
C2		0.047 µF capacitor
C3		1.0 µF capacitor
K1	5V PC board relay—optional (Radio Shack 270-243 or equivalent)	
1200 ohm piezo speaker	(Radio Shack 273-091 or equivalent)	
SPST switch		
9V battery connector		
Metal case, approximately 5" x 3" x 2"	(Radio Shack 270-238 or equivalent)	
Miscellaneous hardware		

Parts Sources:
Mouser Electronics, several locations nationwide
(800) 346-6873

Radio Shack

A PC board is available for $5.50 plus $1.50 S&H from FAR Circuits, 18N640 Field Court, Dundee, IL 60118.

CMOS was chosen because this component series consumes minimal power, thereby prolonging battery life. I wire-wrapped the original design on a phenolic board which was then installed in a metal enclosure to minimize RFI. The printed circuit board shown in Figures 2 and 3 has since been developed to simplify construction. I was able to stuff and solder the circuit board in less than one hour.

I have been quite satisfied with the keyer's operation during my many hours of practice. I have not yet had a chance to connect the unit to a QRP transceiver but hope to do so by the end of the year. Please note: The 2N2222A NPN transmitter key transistor is used in an open collector configuration. The transistor will safely switch a maximum of 40 volts, which may be inadequate for some transmitters, especially the older, vacuum tube variety. Figure 1 details the optional relay circuitry which is required to switch the higher voltages typically found in older radios. Please check the transmitter's operating manual prior to connection of this unit. I hope you enjoy this project as much as I have.

Measuring the Antenna from the Shack

The half-wavelength feedline and how to get it.

by Carroll R. Markivee WØRKU

Perhaps the two most common measurements that you can make on an antenna are its resonant frequency and its impedance at the place where the feedline is connected. Measuring the resonant frequency of the antenna is important in assuring that the antenna will efficiently radiate a signal; measuring the impedance is important in assuring that the feedline will transfer the signal to the antenna.

Making reliable contacts requires transferring maximum signal to the antenna, and radiating maximum signal from the antenna to other receivers. Unfortunately, most of us are in a hurry to get on the air so we cut the antenna to length with a tape measure, connect a piece of coax long enough to reach the shack, and begin to operate. Only after antenna erection do we realize that the SWR is not what we would like it to be. An antenna tuner or transmatch will not resonate the antenna nor improve the power transfer at the feed point to the antenna.

You can also prune the feedline, or lengthen it, to get a different SWR reading. This will not really change anything either. The SWR reading is most accurate when it is telling you the worst possible information it can tell you: the highest SWR reading it can give you. A low reading may be accurate, but it may also be way off base. If the SWR is very high, there will be maxima and minima all along the feedline. If the feedline length is such that your SWR bridge is at a minimum voltage point, the SWR bridge is not telling you how bad things are.

To maximize radiation from the antenna and power transfer to the antenna, we must resonate the antenna and improve the match of the feedline to the antenna.

There are many good instruments available. A dip meter or antenna bridge will give resonant frequency measurement. A noise bridge or a resistance and reactance bridge may be used for impedance measurements. Such measurements must be made at the feed point (see Reference 1) and, to get true readings, we can only make these measurements with the antenna at its operating position.

Making the Measurements

We cannot stand in the air at the feed point with the antenna at its operating height and make measurements. We must use a length of feedline that is an electrical half wavelength at the operating frequency. (Actually, this is even better than standing in the air at the feed point next to the antenna because it reduces body capacitance.)

The half-wavelength piece need not be heavy-duty cable. Any small cable, even twin lead, will do. If a half wavelength will not reach the antenna, use two or three half wavelengths or any integer number. However, replacing the feedline and making multiple measurements and adjustments can be tedious.

The standard method requires many steps:

1) Lower the antenna.
2) Replace the feedline with a half wavelength piece (or two, or three, etc.).

LOOP

3) Raise the antenna to regular operating height.
4) Measure the resistance, reactance, and resonant frequency. If the resistance is within 10% of the feedline impedance and the reactance is between +5 and -5 ohms (a good match), and the resonant frequency within 5%, you have good power transfer and radiation. Go to step 8.
5) Otherwise, lower the antenna again.
6) Adjust antenna length and/or matching section.
7) Go back to step 3.

END OF LOOP

8) Replace half-wavelength feedline with your regular feedline.
9) Raise the antenna.

My method replaces steps 1, 2, and 3 and reduces the loop with an incremental adjustment of the existing feedline. Incremental adjustment is a way to extend your existing feedline to a true half wavelength of feedline (or multiple), without lowering the antenna

CHART 1
TABLE OF LENGTHS OF COAXIAL CABLE YOU CAN USE FOR INCREMENTS OF A WAVELENGTH AT EACH AMATEUR BAND.

FREQUENCY	.01	.02	.04	.08	.16	.32
28.3 MHZ	0' 2.75"	0' 5.5"	0' 11"	1' 10"	3' 8"	7'4"
24.96MHZ	0' 3.1"	0' 6.25"	1' .50"	3' 0"	4' 2"	8' 4"
21.2MHZ	0' 3.6"	0' 7.5"	1' 2.7"	2' 5.4"	4' 10.9"	9' 10"
18.13MHZ	0' 4.3"	0' 8.6"	1' 5.2"	2' 10.4"	5' 8.8"	11' 5"
14.3MHZ	0' 5.4"	0' 10.8"	1' 9.8"	3' 7.6"	7' 3.25"	14' 6.5"
10.12MHZ	0' 7.7"	1' 3.4"	2' 6.8"	5' 1.6"	10' 3.25"	20' 6.5"
7.2HHZ	0' 10.8"	1' 9.6"	3' 7.3"	7' 2.6"	14' 5.3"	28' 10"
3.75MHZ	1' 9"	3' 5.5"	6' 11"	13' 10.6"	27' 8.7"	55' 7"
1.875MHZ	3' 5.5"	7' .2"	14' .5"	28' 1"	56' 2.5"	112' 5"
OTHER PRACTICAL UNITS WHICH MAY BE USED						
ENGLISH UNITS						
(18 - 28MHz.)	3"	6"	1'	2'	4'	8'
(7 - 14 MHz.)	9"	1.25'	2.5'	5'	10'	20'
(1.8- 4 MHz.)	2'	4'	8'	16'	32'	64'
METRIC UNITS						
(18 - 28MHz.)	12.5 CM.	25 CM.	50 CM.	1 METER	2 METERS	4 METERS
(7 - 14 MHz.)	37 CM.	75 CM.	1.5 METERS	3 METERS	6 METERS	12 METERS
(1.8- 4 MHz.)	1 METER	2 METERS	4 METERS	8 METERS	16 METERS	32 METERS

or replacing the feedline. It requires a little patience and some time, but very little expense.

This method requires five or six pieces of coax, each with an inexpensive slide-on coax connector. These are easy to put together. They should have a binary relationship in length, such as 1, 2, 4, 8, 16, or possibly 32. Make up combinations of pieces to convert your existing feedline to a true half wavelength for the time you are measuring it, and remove the pieces when you want to operate. (You still have to lower the antenna once to make the final adjustment.)

You can use any scale you want for finding the sizes of the pieces of coax. I wanted to find the resonant frequency at 3.750 MHz, so I calculated the sizes for 0.01, 0.02, 0.04, 0.08, and 0.16 wavelength at that frequency. Later I added 0.32 wavelength. Chart 1 shows both the actual sizes I used and the corresponding sizes for other frequencies. They are called increments because each small piece (a fraction or increment of a wavelength) can be added to other small pieces to reach a half wavelength.

Instead of fractions of a wavelength, you can "scale" the pieces of coax according to inches or centimeters; these are included in the table. Any scale will work, as long as it is small enough and you have enough pieces. Chart 1 gives a number of examples of lengths that may be useful, and indicates that other measurements may be used. The increments are to be added to your existing feedline as explained below.

To use these pieces of coax:

1) Assemble them into every possible combination of lengths, as shown in Chart 2.
2) Try each combination, adding it to the shack end of the existing feedline.
3) Use your noise bridge or resistance bridge and impedance bridge to determine resistance and reactance at that combination. Write down your readings.
4) Plot these points on graphs.

My antenna was long for the 80 meter band, and I wanted to adjust it to resonate at 3.750 MHz. At the flat portion of the curve on my graphs there is an equivalent half wavelength of the feedline. This is halfway between the peaks of the one-quarter and three-quarter wavelengths. That shows the ideal increment, the amount of added feedline that makes a half wavelength equivalent out of your existing feedline, without lowering the antenna! With that added length in place, you can measure the real resistance, reactance, and resonance.

In my case, the half wavelength was reached by adding 0.34 wavelength. The resonant frequency was 3.025 MHz, and the resistance was 21 ohms with a reactance of +1 ohm. The SWR was 2.5:1 at this point, but the SWR wandered all over the place as the feedline length was changed! The only accurate SWR reading was the one at the half wavelength point. If I had chosen to, I could have made the antenna and feed point match look pretty good by adding 0.45 wavelength of feedline permanently to make the SWR read 1.6:1! But I would only be fooling myself.

The resonant frequency of 3.025 MHz

CHART 2 COMBINATIONS OF INCREMENT UNITS
INCREMENT OF A WAVELENGTH AT EACH BAND

MEASUREMENT NUMBER	.01	.02	.04	.08	.16	.32
1	X					
2		X				
3	X	X				
4			X			
5	X		X			
6		X	X			
7	X	X	X			
8				X		
9	X			X		
10		X		X		
11	X	X		X		
12			X	X		
13	X		X	X		
14		X	X	X		
15	X	X	X	X		
16					X	
17	X				X	
18		X			X	
19	X	X			X	
20			X		X	
21	X		X		X	
22		X	X		X	
23	X	X	X		X	
24				X	X	
25	X			X	X	
26		X		X	X	
27	X	X		X	X	
28			X	X	X	
29	X		X	X	X	
30		X	X	X	X	
31	X	X	X	X	X	
32						X
...						
40				X		X
...						
50		X			X	X
...						
63	X	X	X	X	X	X

The above combinations are assembled and connected (in series).

called for a reduction to 81% of the original length to get to 3.750 MHz (3.025/3.750). I lowered the antenna one time, cut it 19%, and raised it back up. It resonated at 3.740 MHz; the resistance was 48 ohms and the reactance was +1 ohm. The SWR was 1.1:1. That was close enough for me, so I stopped right there.

I removed the extra feedline, and operated with the assurance that I was transferring maximum power to the antenna, and radiating maximum signal. My signal strength reports are up about 10 dB. Best of all, I know that my antenna is operating at peak efficiency!

References:

1. *ARRL Antenna Book*, 16th Edition, 1991, pp. 2-6.

2. *Antenna Impedance Matching*, Wilfred N. Caron, 1989, pp. 2-9.

Velocity Factor

The equation I used for calculating the feedline lengths, including the velocity factor (coaxial cable propagation factor), was: Feet = (486/MHz) x VF x N/50, where VF = velocity factor and N = number of hundredths of a wavelength you want. For example, for 0.02 wavelengths, N = 2; for 0.04 wavelengths, N = 4. The velocity factor I used was 0.70, determined by measurement.

The standard reference tables (from the *ARRL Antenna Book*, 16th Edition, pp. 24-19) of characteristics of transmission lines indicate the following values for the velocity factor in common transmission lines:

Transmission Line	Velocity Factor
RG-8X	0.75
RG-8	0.66
RG-8 Foam	0.80
Belden 9913	0.84
Belden 9914	0.78

I determined the velocity factor of my length of coax with a noise bridge and a general-coverage receiver. I used the simple formula: VF = Lf/984 x N, where VF = velocity factor, L = line length in feet, f = frequency in MHz., and N = number of electrical wavelengths in the line.

To use this formula, select a piece of the coaxial cable you are going to use. It should be equal to, or slightly longer than, either one-quarter wavelength or one-half wavelength for the frequency of greatest interest. Attach a PL-259 coax connector to one end. If it is about one-quarter wavelength long, leave the other end open; if it is one-half wavelength long, then short circuit the other end. Attach it to the noise bridge. Set the noise bridge to zero resistance and zero reactance (R = 0 and X = 0). Tune the receiver for a null in the noise bridge signal, and you have found the frequency (f) to plug into the formula above. N will be either 0.25 or 0.50, according to whether you chose a quarter or a half wavelength. Determine L with a good tape measure.

My calculations showed the VF of the RG-8X I was using to be 0.70, rather than the 0.75 shown in the table. This was probably taking into account the connector used and other unknown factors.

73 Review

Number 11 on your Feedback card

by Peter H. Putman KT2B

Swiech Communication Systems
12218 Greentree Road
Poway CA 92064
Telephone: (619) 748-0708
Price Class: $64.95 (MSRP)

The COY2M3EL "Stealth" VHF Yagi

A 144 MHz antenna from Swiech Communications Systems.

While doing some cleanup this past spring in my amateur radio "barn" (a small shed in my back yard full of masting, antennas and coax), I came across an old, beat-up, bent, dented and otherwise trashable KLM four-element 2 meter yagi. I've owned this particular antenna for about 14 years and it has really been through the ringer, accompanying me on over a dozen mountaintopping trips, more than a few Field Days, and several public service events.

It got me to wondering if anyone made a really durable yet portable yagi for yeoman 2 meter service—as a temporary link antenna—for Field Day use or the odd mountaintop trip. This "ideal" antenna would have to be fairly lightweight yet very durable and take a minimal amount of time to assemble in the field. "Dream on," I thought ... until I made the rounds at Dayton last year!

The COY2M3EL "Stealth"

This nifty three-element 2 meter beam caught my eye the minute I walked past the Swiech Antennas booth: It's jet black with steel hardware and nickel-plated connectors and really resembles something from the Air Force's "stealth" technology program. The boom is round like most conventional yagis, and the elements mount to the boom with a composition block that attaches with a single bolt and wingnut. Black end caps and protective tips on the 1/4"-thick elements finish off the professional appearance.

The "Stealth" measures 38"—quite a bit shorter than most small 2 meter yagis I've ever used, but also heavier by at least a pound. Indeed, the "Stealth" is a very substantial antenna and I have no doubt of its ability to survive severe weather in a permanent installation. However, the slight increase in weight does make a difference when you lug it around for some time in a portable application, so Gene Swiech WB9COY recommends this antenna (and its 440 MHz companion, not reviewed) for temporary and permanent point-to-point link operations.

Assembly of the COY2M3L is very simple—you just slide each element and its mounting block onto the boom, center them over the mounting holds, and insert a stainless #8 screw and wingnut to fasten it. Gene also intended for the COY2M3L to be carried in a standard nylon zipper bag, hence the protected element ends and boom caps. The boom-to-mast clamp fastens directly through the boom with a single U-clamp, and you can opt for either vertical or horizontal operation.

Performance

Swiech claims 6.1 dBd (over a dipole) gain for the yagi, and while I couldn't accurately verify this number I did take a look at the pattern and VSWR using a simple test range with a 2 meter source and whip antenna several wavelengths distant. At 45 degrees either side of the test signal, it was reduced by 2.5 dB while at 90 degrees, the signal was down by 16.5 dB, and the front-to-back ratio clocked in at 10 dB—adequate for foxhunting or link work.

The feed is a gamma match design, which usually results in a narrowband match with corresponding hi-Q response. I swept the antenna from 140 MHz to 150 MHz, showing 2:1

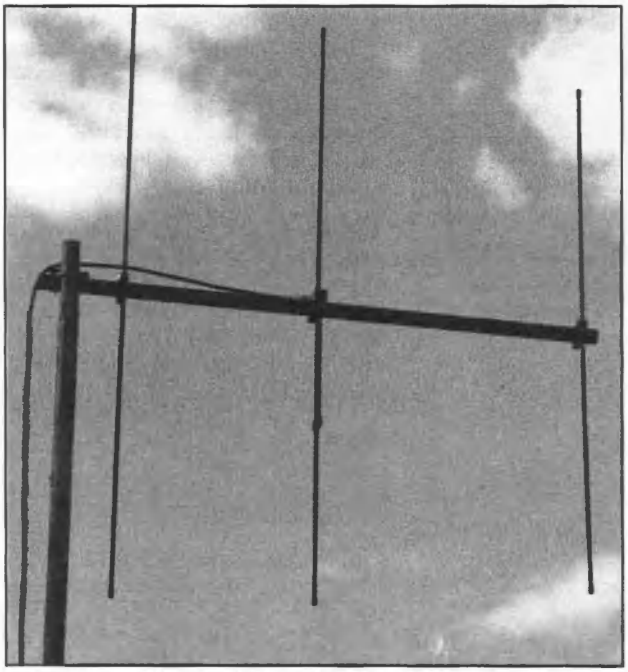


Photo A. The Swiech COY2M3EL yagi.

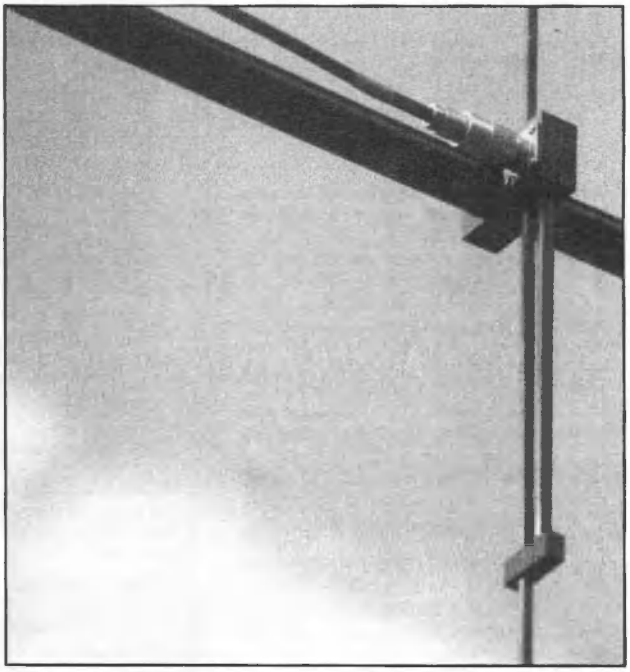


Photo B. Close-up of the gamma match element mounting block.

SWR at 143 and 149.5 MHz. At 144 MHz, it dropped to 1.4:1 and at 146 MHz the Bird 43 showed less than 1.05:1. VSWR does not increase appreciably until about 149 MHz—at 148 MHz, it was less than 1.25:1. In general, the COY2M3L showed very good response across the entire band.

In Actual Use

I loaned the COY2M3EL out to a local club for a foxhunt this past summer, along with a couple of step attenuator boxes and a small mast. The consensus was (A) It's a bit heavy for holding in your arm over any length of time, and (B) who cares?—it's the sharpest-looking antenna in the crowd! The pattern was adequate for DFing with the step attenuators, so perhaps a mobile installation would be more appropriate when on a hunt.

The acid test: Would it survive one of my long hikes up a mountain loaded down with radios, batteries and masting (especially when I'd "whack" into a rock or tree on the narrow trail)? Well, the COY2M3EL came through looking a lot better than the rest of my antennas. Although I prefer square boom material to make element alignment easier, I will say that a strong round boom generally holds up better in the long run. Not only that, but the COY2M3EL's compact size took up less room in my pack.

As far as contest performance goes—well, how much can you expect from a short three-element yagi? The COY2M3EL was just perfect for making dozens of 2 meter FM contacts, while I relied on my nine-element Tonna for the long-haul SSB and CW work. No doubt about it, the COY2M3EL is far better suited for general-purpose temporary and emergency portable and fixed use than in contest operation, but I bet it will look and work just as good 10 years after you buy it. How many antennas can make that claim? 73

Tone Burst Generator and Decoder

Versatility and control for under $5.

by Klaus Spies WB9YBM

In the United Kingdom, tone bursts have been used for many years to key up repeaters. This is not only an alternative to PL—if it's used in addition to PL, many more functions in remote bases or repeaters can be accessed remotely.

When initially investigating tone bursts, I was shocked at the price of commercially available units, considering the simple function. I grabbed for my junk box as quickly as I threw out my stack of catalogs!

Of the wealth of ICs available that generate tones, I decided on using the 555, because it is commonly available and easy to work with. Half of a 4538 (a resettable retriggerable one-shot) is used to trigger the 555 for a predetermined period of time, calculated by T = RC. Half will also be used in the decoder. With only six ICs, the whole circuit won't take up much room in a standard-size transceiver, or on a ham shack bench (if left external in its own box).

The 567 decoder/PLL has been used for many years as a DTMF tone decoder, making it a time-proven device. U1B, with the help of U5, makes sure the tone is decoded for the proper length of time before giving a valid output, eliminating falsing.

Final Assemby

If used as an external accessory to your transceiver, this circuit should be enclosed in a metal box connected to the ground of the power supply, for proper shielding. A shielded audio cable is also highly recommended for all audio lines.

Whether it's used as a stand-alone or built-in accessory for your transceiver, unused gates should be grounded as shown. RF bypass capacitors should be used on all input and output leads, and depending on the levels of RF in your shack (both from your own equipment and any local commercial broadcasters), choke coils and/or ferrite beads are definitely a good idea.

The entire circuit can be built for less than five dollars—a definite savings over commercially built units!

Continued on page 48

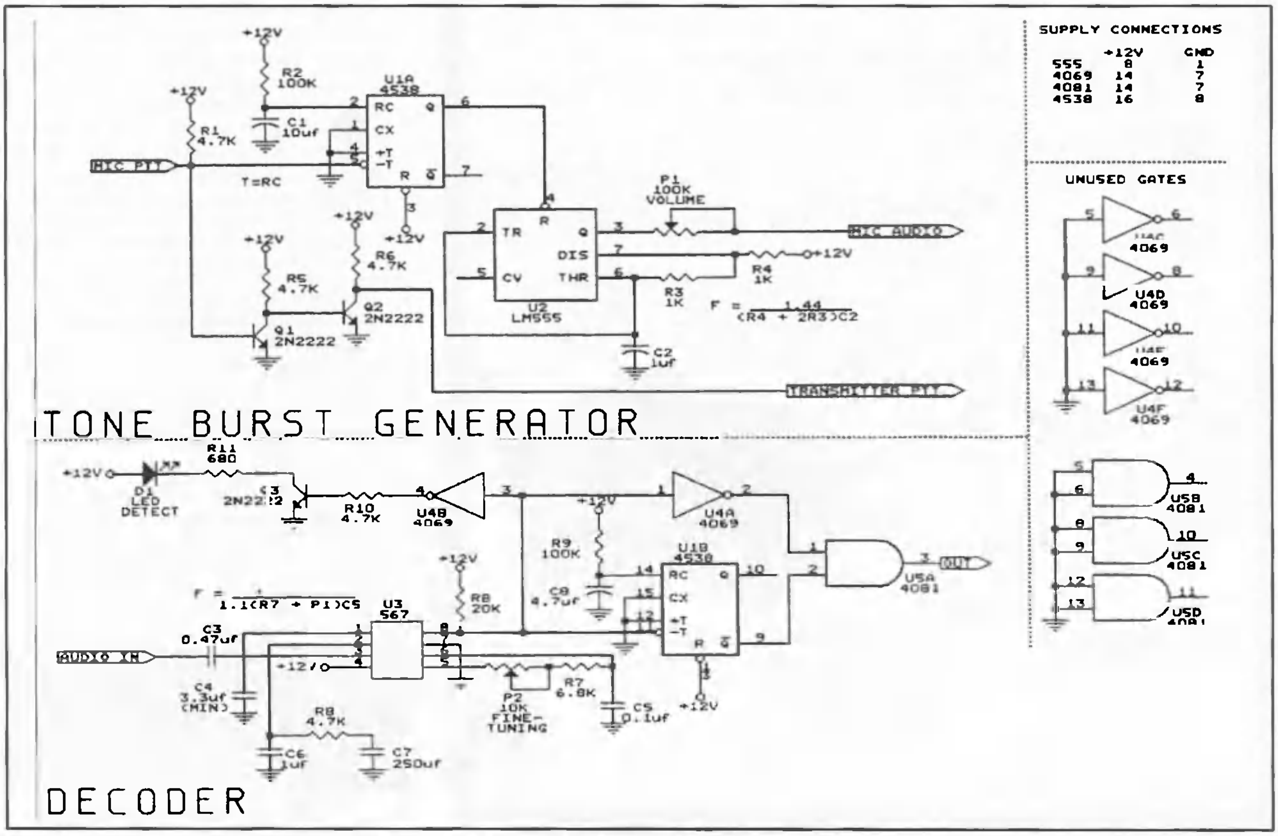


Figure 1. Schematic for the Tone Burst Generator/Decoder

Parts List

Item	Quantity	Reference	Part
1	1	C1	10 µF
2	2	C2,C6	1 µF
3	1	C3	0.47 µF
4	1	C4	3.3 µF
5	1	C5	0.1 µF
6	1	C7	250 µF
7	1	C8	4.7 µF
8	1	D1	LED
9	3	P1,R2,R9	100k
10	1	P2	10k
11	3	Q1,Q2,Q3	2N2222
12	5	R1,R5,R6,R8,R10	4.7k
13	2	R3,R4	1k
14	1	R7	6.8k
15	1	R8	20k
16	1	R11	680
17	1	U1	4538
18	1	U2	LM555
19	1	U3	567
20	1	U4	4069
21	1	U5	4081

Parts Sources:

Digi-Key Electronics, (800) 344-4539

Tri-State Electronics, (708) 255-0600

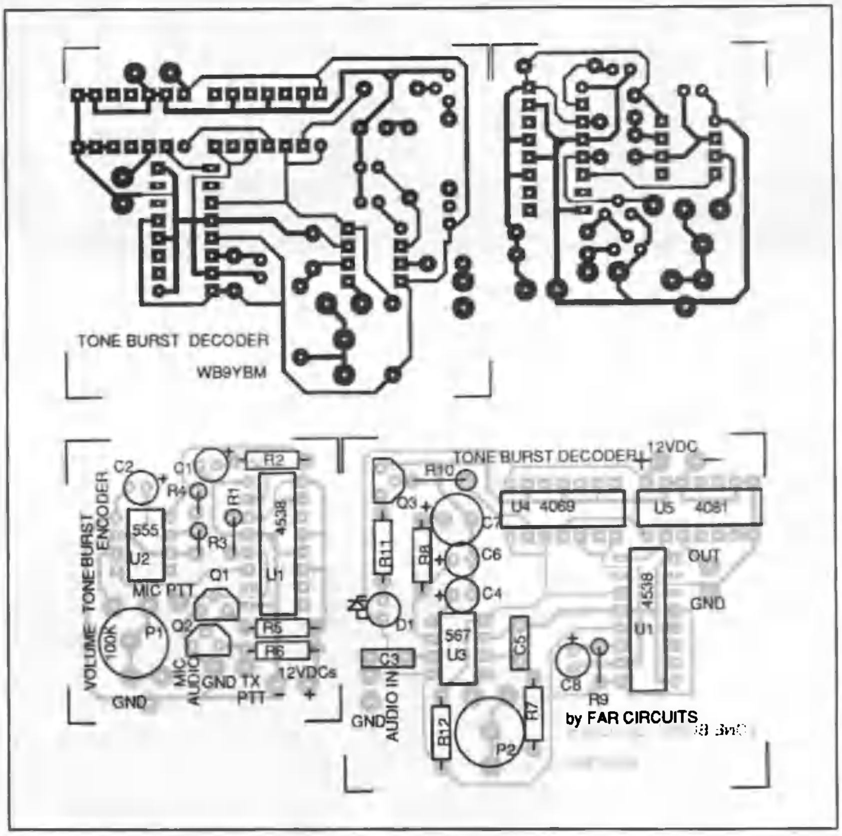


Figure 2. (right) Drilled and etched PC boards are available for $6.00 plus $1.50 S & H per order from Far Circuits, 18N640 Field Court, Dundee, Il 60118.

Number 13 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Parametric Amplifiers (Huh?!?)

The *parametric amplifier* (see Figure 1) is capable ol high gain and low noise operation in the UHF and microwave regions, but is fundamentally different from conventional forms of amplifier. The parametric amplifier takes its name from the fact that amplification occurs through exciting a circuit parameter. This amplifier is actually misnamed because it is the reactance parameters (X_C and X_L) that are excited. Perhaps a better name is *reactance amplifier*.

A reactance differs from a resistance in that the latter dissipates power, while reactances store energy and redeliver it to the circuit without any power dissipation. If the reactance can be varied at a rapid rate, then the energy stored and discharged by the reactance can be used to amplify the signal. Although either capacitors or inductors can be used in parametric amplifiers, it is the capacitive reactance that is used in practical circuits because suitable voltage variable capacitance diodes ("varactors") are easily available.

In a varactor, the capacitance is a function of the reverse bias potential applied across the PN junction of the diode. A typical varactor useful in parametric amplifiers has a breakdown voltage of -4 to -12 volts, and a zero-bias junction capacitance of 0.2 to 5 picofarads. The cutoff frequency should be high with respect to the operating frequency. Generally, the noise figure is improved with higher diode cutoff frequencies.

The low noise figure of the parametric amplifier derives from its use of a reactance as the active element. In an ideal circuit, the noise generated is zero. In real circuits, however, there are resistive losses associated with the tank circuit and the varactor, and these give rise to thermal agitation ("Johnson") noise. In addition, other processes take place inside the diode to generate noise. As a result, parametric amplifiers exhibit low noise factors, but not zero.

Parametric amplifiers can be operated in either of three modes: *degenerative*, *non-degenerative*, or *regenerative*. We will consider both modes, and provide a tool for evaluating parametric amplifier circuits.

Degenerative Parametric Amplifiers

Figure 1A shows the basic parametric amplifier. The varactor diode is connected so as to switch the signal on and off to the load as an external "pump" signal is applied. Although shown here as a series connected switch, both series and parallel connected diodes are used. The signal and pump waveforms (see Figure 1B) are phased such that the diode capacitance is fully charged when the peak of the pump signal arrives. The charge is constant so, using the formula V = Q/C, the voltage must increase as the pump voltage drives the diode capacitance down.

Parametric amplification occurs when the peak of the pump signal coincides with both positive and negative peaks of the signal waveform, increasing the pump potential (as at the peak) drives the diode capacitance to minimum, and it is at this time that capacitor charge is dumped to the load. To achieve degenerative parametric amplification, the phasing must be precise, and this requirement means that the pump frequency must be the second harmonic of the signal frequency.

A severe limitation to the degenerative parametric amplifier is the necessity of precisely phasing the pump and signal waveforms. Drift in either signal can reduce the gain or prevent the circuit from operating. A broader bandwidth method is to use the non-degenerative or regenerative parametric amplifier circuits.

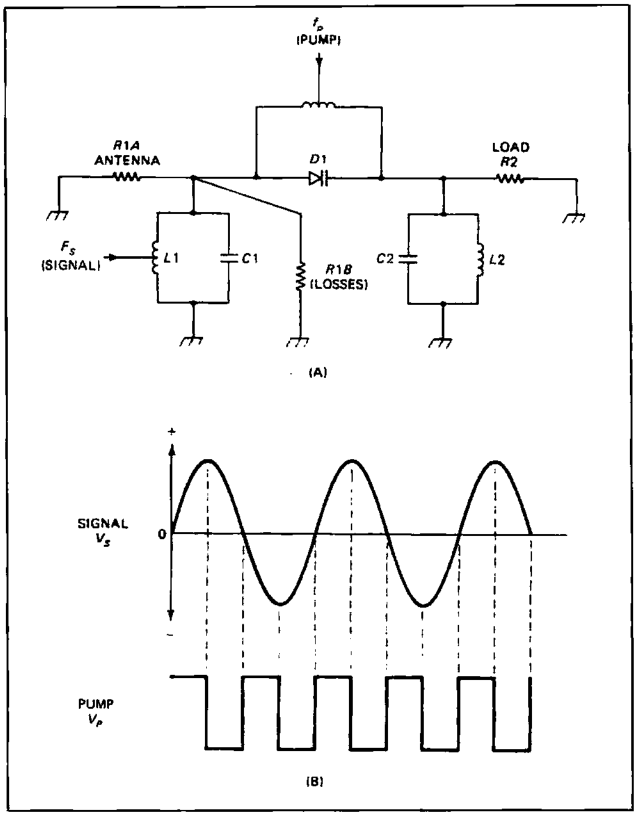


Figure 1. a) Parametric amplifier circuit. b) Operating waveforms.

Non-Degenerative and Regenerative Parametric Amplifiers

The requirement for precise phasing in the degenerative parametric amplifier is relieved somewhat in the non-degenerative case (Figure 2) by the presence of a third frequency. In addition to the signal frequency (i_S) and the pump frequency (f_p), we now also have an *idler frequency* (f_i). In Figure 2 note that the third resonant tank circuit (L3C3) is tuned to f_i. The idler fre-

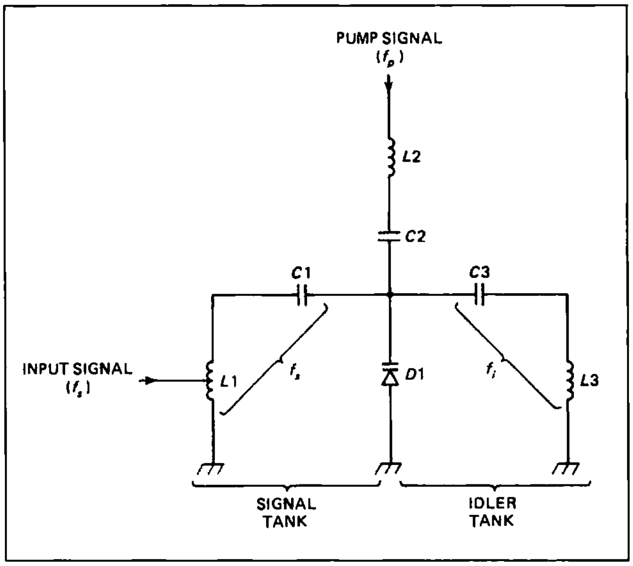


Figure 2. Parametric amplifier ciruct.

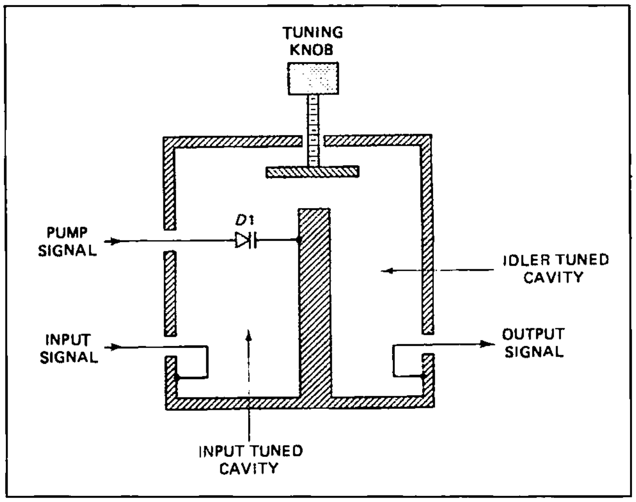


Figure 3. Microwave parametric amplifier.

quency is the output frequency of the circuit which, incidentally, also operates as a frequency translator or converter.

There are two general cases of non-degenerative parametric amplifiers: *up-converters* and *down-converters*. In the up-converter case the idler frequency is the sum of the pump and signal frequencies:

$$F_i = F_s + F_p$$

In the down-converter case, the idler frequency is the difference between pump and signal frequencies:

$$F_i = F_s - F_p$$

Power gain is defined as the ratio of the output power to the input power. In the case of a lossless circuit, the gain of the up-converter (f_i greater than f_s) is:

$$G = \frac{F_i}{F_s}$$

The down-converter case is actually a loss (attenuation), rather than a power gain.

The third category of parametric amplifier is the regenerative circuit, and is actually a special case of the non-degenerative amplifier. In the regenerative amplifier the pump frequency is the sum of the signal and idler frequencies. In this case power gain is negative, which implies a negative resistance characteristic. As a result, the circuit is regenerative. Implicit in this property, if the circuit can be kept out of oscillation, is very low noise coupled with very high gain.

Noise In Parametric Amplifiers

The low noise capability of the parametric amplifier is a result of the fact that the amplifier element is a reactor rather than a "resistor." In an ideal parametric amplifier the noise figure is zero, but in practical circuits we have two noise contributors: *circuit losses* and *frequency conversion noise*. These sources combine to create a non-zero noise factor of the order:

$$F_n = \frac{R_a}{R1} + \frac{F_s}{F_i}$$

Where:

F_n is the noise factor
R_a is the antenna impedance resistive component
R1 is the sum of circuit resistive losses
f_i is the idler frequency
f_s is the signal frequency

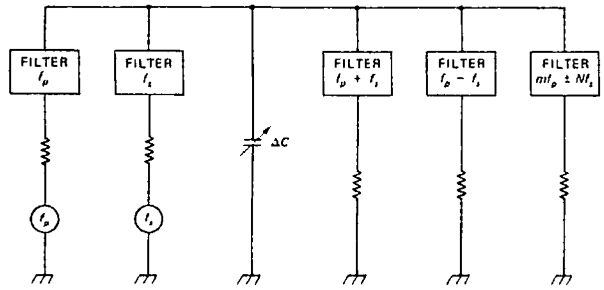
Some authorities recommend a pump frequency seven to 10 times the signal frequency for lowest noise operation.

Microwave Configuration for Parametric Amplifiers

The circuit examples presented thus far show inductor-capacitor (LC) resonant tank circuits for the various frequencies. These circuits work well in the UHF and lower microwave region. At higher microwave frequencies, however, the LC tank circuit fails to work well and is not practical. Therefore, we see parametric amplifiers with resonant cavities (Figure 3) in place of resonant tank circuults. A tuning disk tunes the cavities to resonance.

The Manley-Rowe Relationships

In 1957 Manley and Rowe proposed a means for evaluating parametric amplifier circuits. Consider the equivalent circuit in Figure 4. In this circuit we have a variable capacitance as the reactor element and two signal sources: the signal frequency (f_s) and the pump frequency (f_p), both of which are shown as generators. In series with both generators are filters that pass the generator frequency and totally reject all other frequencies. There is also a series of loads, each of which is isolated from the others by the same kind of ideal narrowband filter. The frequencies of these filters are: ($f_p + f_s$), ($f_p - f_s$), up to ($mf_p \pm nf_s$) (where M and N are integers). The Manley-Rowe relationships are shown at the bottom of Figure 4.



$$\sum_{M,N} \frac{mP_{M,N}}{Mf_p + Nf_s} = 0 \quad (1)$$

$$\sum_{M,N} \frac{NP_{M,N}}{Mf_p + Nf_s} = 0 \quad (2)$$

M, N = INTEGERS
MANLEY-ROWE EQUATIONS

Figure 4. Equivalent circuit for Manley-Rowe relationship analysis.

In working with Manley-Rowe equations we recognize the following algebraic sign conventions regarding power:

1. +P is assigned to power flowing either into the capacitor, or from the pump and input signal "generators," and
2. -P is assigned to power flowing out of the capacitor or into a load resistance.

Stability of the parametric amplifier is determined by the sign of the power flowing with respect to the capacitor. If the power from the signal flows into the capacitor, then the stage is stable. Because we deal with integers from 0 through the *ith*, we can check not only the fundamental frequencies (m and n are 1), but also their respective harmonics (m,n are integers greater than 1). Some of these combinations are stable, while others are unstable.

Parametric amplifiers are a bit exotic, but were once quite popular with the microwave and upper UHF crowd. If you want to research this matter, see older issues of the various ham magazines, especially those with a technical slant.

HAMSATS

Number 14 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

A Fiery End

UNAMSAT-1 from Mexico and TECHSAT-1 from Israel were scheduled for launch on March 28th from the Plesetsk facility in Russia. The end result was not new hamsats in orbit.

Last month's column provided details on the capabilities of the two amateur satellites. UNAMSAT-1 was a microsat-class satellite to be used for digital store-and-forward activities and meteor-scatter studies. TECHSAT-1 was to also provide digital message operations, in addition to carrying a new imaging experiment providing precompressed picture files on the digital downlink frequency.

Reports from Russia just after the launch attempt were sketchy. Many conflicting accounts were heard and passed through amateur-radio channels. Some reports stated that the satellites had achieved orbit, while others described a watery end due to a failed fifth stage. Unfortunately, the latter story held the most truth.

Two weeks prior to launch a video report was given from Plesetsk through the Moscow Ostankino Television First Channel Network. Reporters Yan Borlin and Sergei Telov described the event as a civilian venture involving three satellites to be sent into orbit by a strategic SS-25 (TOPOL) missile. The rocket for the project was built by the Moscow Heat Technology Institute, the organization that originally designed the military TOPOL. The reporters went on to explain that the experimental launches are designed to demonstrate the possibility of large-scale conversion of the strategic missiles for commercial use. Otherwise, the SS-25s would end up as scrap within a few years due to treaty terms specifying arms reductions.

David Liberman XE1TU, Project Manager for UNAMSAT-1, went to Plesetsk with students from the Autonomous University of Mexico (UNAM). David reported that the integration of the Mexican microsat went perfectly. Removal from the packing box to installation and test on the rocket took only 35 minutes. The Russian mechanical satellite model (non-operational payload) and TECHSAT-1 were also attached without problems.

David and the rest of the participants and observers were ready for launch just after noon on March 28th. They watched the attempt from a location five kilometers from the mobile launcher system. The SS-25 started from a horizontal position. In less than 15 seconds it was hydraulically lifted to vertical. David said that two seconds later the first stage ignited and there was no turning back. A local PA system gave updates on altitude for the launcher that was rapidly disappearing into the cold Russian sky.

When the announcer got to the fourth-stage progress, the reports stopped. No explanation was immediately given. The group was eventually told that telemetry from the rocket had quit.

At the banquet that evening few were eating and the mood was somber. Just before midnight David boarded the train for Moscow. The 18-hour trip seemed to last forever. Back at the Moscow University ham shack nothing had been heard from either UNAMSAT-1 or TECHSAT-1. The loss of telemetry from the rocket was not a simple fault. A failure had occurred and the satellites never made it to orbit.

Later reports continued with some confusion. Some said the fifth stage failed, while others blamed the fourth-stage engine. Careful study of the events shows that the fourth stage probably ignited early. This caused the rocket to explode somewhere over the Ural mountains. The would-be hamsats came back to earth, impacting on land, far downrange from the launch site.

The Next Step

David and the UNAM students have decided to prepare their second set of microsat satellite modules for flight. Two sets were made. While the best set met a fiery end, the others are functional and can be checked, aligned, calibrated, tested and readied. The only expensive items missing are solar panels. Work has begun to acquire more for UNAMSAT-2.

Negotiations have begun to allocate another launch. XE1TU and the UNAMSAT crew will continue to provide updates on progress toward the next step. The TECHSAT team in Haifa is also reported to be working toward at least one replacement for their ill-fated spacecraft.

AMSAT President Bill Tynan W3XO posted a message expressing the feelings of hamsat chasers everywhere. "Speaking for all of the Amateur Radio Space enthusiasts around the world, I extend to both the UNAMSAT and TECHSAT teams our sympathy over their losses. It goes without saying that everyone is heartened by the resolve of both groups to rebuild and try again."

More Signals From Space

Astronaut/Cosmonaut Norm Thagard has been flying high aboard the *Mir* space station operating as RØMIR. He has made many voice contacts with hams around the world. In June, STS-71 will arrive at *Mir* to drop off some passengers and pick up Norm for the ride home. Until then he will continue to make QSOs using FM on 145.55 MHz simplex.

> ***"In order to alleviate confusion and interference with the* Mir *ham operations, STS-71 will use a different set of ham frequencies."***

The *Mir* rendezvous mission of STS-71 will also feature SAREX, the Shuttle Amateur Radio EXperiment, with a new twist—no SAREX gear will be aboard. A Motorola radio on the flight used for communications with *Mir* is also capable of operation in the 2 meter ham band and will be used for that purpose when available.

Usually SAREX operations use a downlink of 145.55 MHz. In order to alleviate confusion and interference with the *Mir* ham operations, STS-71 will use a different set of ham frequencies. The global downlink for STS-71 will be 145.84 MHz, while uplinks will be on 144.45 and 144.47 MHz. Since STS-71 has none of the usual SAREX equipment, there will be no packet operation, only voice. Be careful to transmit exclusively when activity is heard on 145.84 from the shuttle.

To make matters more interesting, the current shuttle schedule has STS-70 set for launch just days before STS-71. STS-70 is also a SAREX mission, but with the usual SAREX gear. This means that the customary SAREX frequency plan will be in effect for STS-70. As a reminder, normal SAREX operation uses a 145.55 MHz downlink. For voice, the uplinks are 144.91, 144.93, 144.95, 144.97 and 144.99 MHz over North America. When the packet system is on, the uplink is 144.49 MHz. Although schedule changes will likely move launch dates for STS-70 and STS-71 a bit, early June promises some exciting ham-in-space adventures on 2 meters.

Field Day 1995

Field Day is once again just around the corner on June 24th and 25th, and AMSAT is proud to announce the 1995 AMSAT Field Day competition. Last year's effort was very successful. The competition is to encourage the use of all amateur satellites, both analog and digital.

Here are the rules for the 1995 AMSAT Field Day competition.

Analog Transponders

Each satellite transponder is considered a separate band. This means that AMSAT-OSCAR-13 Mode "S" is separate from A-O-13 Mode "B."

All phone QSOs and all CW QSOs on a given satellite transponder are considered separate bands. This means that A-O-13 Mode "S" CW is separate from A-O-13 Mode "S" phone.

Therefore, for reporting purposes, A-O-13 has four possible "bands" including Mode "B" CW, Mode "B" phone, Mode "S" CW and Mode "S" phone.

All packet/RTTY/ASCII/AMTOR QSOs through analog transponders are counted as CW QSOs.

Phone QSOs count for one point and CW QSOs count for two points. Cross-mode (CW-phone) contacts are not allowed.

The use of more than one transmitter at the same time on a single satellite transponder is prohibited. This means that two stations at the same Field Day site can operate through A-O-13 at the same time, but only if one is operating Mode "S" and the other Mode "B." If two stations at a given site are set up for Mode "B" operation, only one can be on A-O-13 (CW or phone). The other station can be used for different hamsats (like A-O-10), or for other Field Day activities.

Digital Transponders

For the pacsats (L-O-19, K-O-23, etc.), each satellite is considered a separate band.

Do not post "CQ" messages. Simply upload *one* greeting message to each satellite and download as many greeting messages as possible from each satellite. The "subject" of the uploaded file should be posted as "Field Day Greetings," and addressed to "ALL." The purpose of this portion of the competition is to demonstrate digital satel-

lite communications to other Field Day participants and observers.

The following uploads/downloads each count as a five-point digital contact:

(a) Upload of a Satellite Field Day Greetings file (one per satellite).

(b) Download of Satellite Field Day Greetings files posted by other stations. Other non-Field Day files are not to be counted for the event.

Satellite digipeat QSOs do not count for any score, and the use of gateway stations to uplink/downlink is not allowed.

The *Mir* PBBS is not to be used for Field Day operations.

If F-O-20 is active, the JA transponder can be used for analog CW and phone activities under the analog transponder rules, and the JD system can be used as a separate transponder under the digital rules.

Sample Satellite Field Day Greetings File:

"Greetings from K5ERP Field Day Satellite station near Galveston, Texas, with 24 participating members in the HTTY Club. All the best and 73!"

Note that the message stated the call and name of the group, where they were located, and how many were in attendance.

Operating Class and Reports

Stations operating portable and using emergency power (as per ARRL Field Day rules) are in a separate operating class from those at home connected to commercial power.

A Satellite Summary Sheet should be used for submittal of the AMSAT Field Day competition results. A copy of this form will be in the *AMSAT Journal*, or can be obtained from me at the address above for a self-addressed-stamped envelope. Deadline for submissions is August 1, 1995.

Competition was tough in 1994 and should be even tougher in 1995. The station submitting the highest score for portable operation using emergency power will receive a plaque at the AMSAT General Meeting and Space Symposium in Orlando, Florida, in October. AMSAT hopes this event provides satellite operators with the practice necessary to set up a ground station and effectively operate via the satellites in an emergency situation. Remember that Field Day also provides a good opportunity to expose newcomers to the amateur-radio satellites. Most of all, it should be a lot of fun for all who participate.

HOMING IN

Number 15 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KOOV
P.O. Box 2508
Fullerton CA 92633

Wideband Doppler, Part 2

This week, as almost every week, there are several messages on packet bulletin boards and online services from hams wanting to know how to get started in radio direction finding (RDF). Even though most of those writing know little about various RDF methods, many specify that they want information on doppler sets. "Doppler" is the word that comes to mind when most hams think of RDF, despite the fact that it is not the most popular way to do transmitter hunting in many areas of the country, nor is it the least expensive.

Doppler sets are appealing because they provide instant bearing readout and are easy to install and use on almost any vehicle. With a little practice, you can have good results with a doppler in most RDF situations. In "Homing In" for April, I gave you some important design considerations for doppler antennas and described a new switching circuit for the Roanoke Doppler, a popular build-it-yourself RDF set.

The new switcher has lower loss for greater sensitivity, plus better off-whip isolation for steadier readings in areas with high levels of signal reflections. Best of all, it eliminates the need for the coax lines from the switcher to each of the four whips to be a critical fraction of a wavelength. This means that a much wider frequency range is possible for a given antenna set.

More Than 2 Meters

Theoretically, the radius of rotation of a multi-whip doppler array (distance along the ground plane from array center to any whip base) must be less than one-quarter free-space wavelength at the frequency being received. This means that the four-antenna square array pattern must not be more than 0.35 wavelength on a side. My experiments and those of others have shown that about 0.22 wavelength on a side is optimum.

Closer spacing increases mutual coupling between whips, which in turn increases undesirable directivity effects. Furthermore, it produces lower deviation of the doppler tone in the receiver, degrading the signal-to-noise performance. Wider spacing increases doppler tone deviation, which can be detrimental on some receivers, depending on their IF filter characteristics.

A 0.22 wavelength array works well over a ±20 percent frequency range. The 18-inch array described in the April issue covers 121 through 174 MHz. Bearing accuracy is unacceptable outside this range. Of course, sensitivity is maximum near the resonant frequency of the quarter-wavelength vertical whips.

Civil Air Patrol volunteers, Coast Guard Auxiliary members, and others interested in search and rescue can use this array on the 120 MHz aircraft band and the 160 MHz marine band. Keep in mind that Doppler processing works only with FM receivers. A scanner or marine set receives narrowband FM from 138 to 174 MHz, but most scanners and all transceivers have only AM detectors in the 120 MHz aircraft band. They won't work with a doppler RDF set. Instead, you must use a receiver that features selectable narrowband FM mode for the aircraft band, such as the Regency MX-7000.

Photo A. Inside the base of the Barjan 11 meter antenna before modification. Note the white insulating paper between the magnet and the bottom foil.

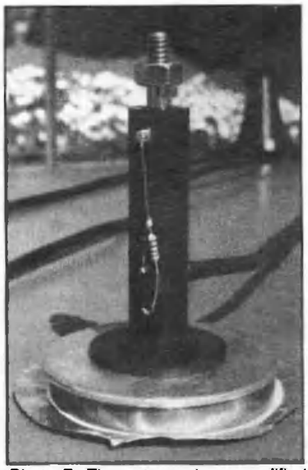


Photo B. The antenna base modified for doppler use. After taking the photo, I added some electrical tape to prevent a short from the PIN diode cathode to the resistor lead.

The new wideband switcher can be scaled for other VHF and UHF frequency ranges. Tom Lewis AB5CK of North Richland Hills, Texas, had been unsuccessful in modifying the original Roanoke Doppler antenna to work on the 70 cm band. I encouraged him to try the new switching circuit with appropriate whip length and spacing. He built a one-piece array with 6-inch-long whips in a 5-inch square pattern. Inductors and capacitors were selected for UHF.

"The 440 operation was fantastic," Tom says. "It worked just as well as I could expect a doppler to work. A friend of mine has a 440 MHz repeater and he was having interference that would kick up the squelch and cause havoc. I hooked up the doppler and within a half mile of the repeater I found a television preamp that was radiating a very low level spur on his input frequency. You figure that if a signal that weak can be detected a half mile away, it's doing pretty well."

Figure 1 gives array sizes and component values for doppler antennas centered on three UHF/VHF bands. You can use this data to build one-piece arrays on a metal plate, like the one in the T-hunt book. The length of the corner radials extending from the whip base should equal the whip length. Turns data for inductors are for single-layer close-spaced chokes on 3/16-inch forms, wound with AWG 26 enameled wire.

More Frequency Agility

Some commercial doppler sets have individual magnetic-mount whip bases instead of a one-piece array. Coaxes from each whip go inside the vehicle to the switcher, located in the control/display box. One set of whip bases can be used over a very wide frequency range by placing them on the vehicle roof at appropriate spacing for the frequency of the hunt.

The requirement for exact dual quarter-wavelength coaxes between switcher and whips made it impossible

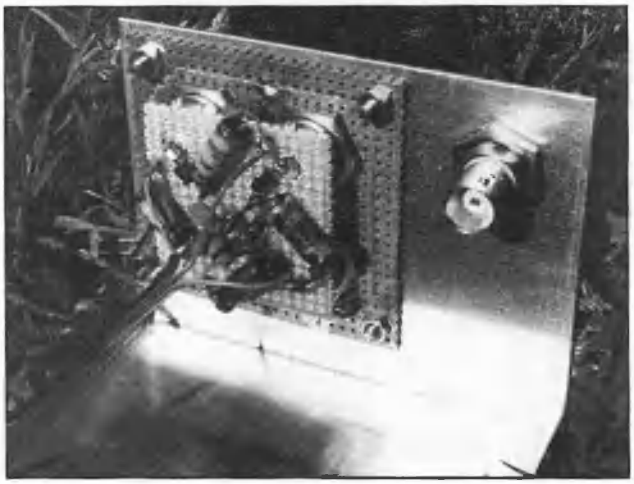


Photo C. The new Roanoke Doppler antenna switcher mounted on the back panel of the display box. The two display circuit boards and their connectors are not installed yet. A short length of RG-58 coax (not shown) ties the switcher common point to the BNC feedthrough adapter for connection to the VHF receiver.

Photo D. Magnetic-mount doppler whips can be placed quickly on any vehicle with a ferrous metal top and moved about to cover a wide range of frequencies. Now my second car has RDF gear on board.

to do this with the old Roanoke Doppler switcher. Coax lengths are not critical with the new switcher (so long as they are equal lengths). So I decided to make a mag-mount antenna set to go on my commuting vehicle.

The VHF mag-mount mobile whips I saw at ham stores and in the catalogs were all too expensive for my taste. They were also difficult to modify for PIN switching. Admittedly, my search was not exhaustive, so let me know of any that you find suitable. Remember that four are required, which escalates the project cost.

While gassing up at a truck stop, I discovered some Citizens Band whips by Barjan Products (Model 300-102). They have large magnetic bases, making them easy to modify. The whip holder has a setscrew mount, so exchanging whips for band changes is simple. Best of all, they are cheap by comparison. Other brands of CB antennas with base loading coils and 36-inch radiators should work as well for this project.

Modification of each antenna was easier than I anticipated. I removed the whip and holding nut, then carefully slit the bottom foil to remove the plastic base cover (see Photo A). Besides covering the magnet to prevent paint scratches, the foil provides capacitance coupling of RF to the ground plane (vehicle body). As supplied, the foil is insulated from the magnet and coax shield. This is important, because the coax shield is not DC-grounded with the new switcher.

After unwinding the 11 meter loading coil and removing the matching capacitor, there is plenty of room to wire in a PIN diode and current limit resistor, as in Photo B. To minimize loss, I shortened the 17-foot coax lines to a length appropriate for my sedan installation. Remember that for accurate bearings, all four lines must be exactly equal lengths.

Cut each vertical element to one-quarter wavelength, calculated with the standard formula $L = 2808/F$, where L is element length in inches, and F is frequency in MHz. For the antenna base of Photo B, the feed point of the radiating element is the cathode end of the PIN diode. Taking into account the length of the whip base and the depth of the hole in the whip holder, the 3/32-inch diameter CB whip must be cut to 16.9 inches to achieve an effective 19.25-inch quarter-wavelength element for 146 MHz. I cut the leftover rods into whips for the 125 and 70 cm bands. You could also use 3/32-inch diameter welding rod (stainless steel or bronze) to make whips.

The etched boards by Marly Mitchell N6ZAV for the Roanoke Doppler control circuits fit into the 6 x 4 x 3-inch painted aluminum cabinet (LMB model CR-643) shown in the T-hunt book, leaving room on the back panel for the new antenna switcher (Photo C). This switcher is built on a 2-1/2-inch square of perforated board, copper-clad on the interior side. The CB antennas came with PL-259 connectors, so I installed four SO-239 receptacles. For UHF, it might be better to convert to BNC fittings for minimum loss.

I used a Dremel Moto-Tool as a router to insulate the center of the board where the four single-hole coax fittings mount. This part of the board floats at +3.7 volts DC, so use care to prevent the coax connectors from shorting to the box. A "nibbling tool" is an easy way to make a two-inch square hole in the rear panel to clear these connectors.

A 1-1/2-inch square piece of unclad perfboard fits over the center pins of the coax receptacles. Four capacitors (C101-C104), four PIN diodes (D101-D104) and four RF chokes mount on this board. C105-C108 connect between this board and the isolated return on the copper-clad board. Keep leads as short as possible on all these components and make sure the path length through D101-D104 and C101-C104 from common point to center conductor of each SO-239 is equal. Note the symmetry of the layout in the photo.

When it was time to make the RF chokes, I was out of plastic rod stock, so I wound each on the shaft of a 3/16-inch drill bit, taped down the ends of the winding, and brushed on some Q-dope. When the coating was dry, I could slide the choke off the bit in one piece (with a little persuasion) and install it. Covering the installed choke with more Q-dope will prevent it from peeling apart because of road shock and vibration. (Hint: Finished coils are fragile before the second coating. It's easier to strip enamel from the wire ends before winding instead of afterwards. It takes 19.5 inches of wire to make a 24-turn coil.)

Inductors and capacitor values are not nearly as critical as whip length and spacing, so long as these components have self-resonant frequencies near the high end of the array operating range. For the mag-mount switcher, I used values for the 2 meter array listed in Figure 1. If you will be using yours mostly on another band, choose values from Figure 1 accordingly.

Using the Mag-Mount Array

Be sure that your array "rotates" in the proper direction and in proper sequence. I numbered the whips from 1 to 4 going clockwise (as viewed from above the car), beginning with the left front (LF). To minimize the chance of installation error, I marked the whip bases, coax plugs, and box receptacles with location designators (LF, RF, RR, LR) instead of numbers.

Optimum spacing of the four array

sides is given by the formula D= 2630/F, where D is distance between adjacent whips in inches, and F is received frequency in MHz. This distance is not critical, but use care to place the whips in a perfect square pattern on the roof and align the array sides parallel to the sides of the vehicle.

It's tedious to set out the whips using just a ruler or tape measure. I made separate cardboard templates for optimum 146, 223, and 440 MHz spacing. Cutouts in the template corners match the whip bases. Emplacement is fast and misalignment is avoided with the templates. Once the whips are in place, I remove the template so it doesn't get rained on or blow away.

When changing bands, check the bearing accuracy of your setup using a known signal source before setting out to find an unknown emitter. In my case, readjustment of the calibration control has not been necessary when whip length is within 20 percent of resonance. On the other hand, using 2 meter whips on 224 MHz gave about 90 degrees bearing error. The presence of other VHF antennas on your vehicle may cause bearing error on some bands.

In my trials with the Roanoke Doppler and new switcher, I generally had excellent bearings on vertically polarized signals that provided at least moderate quieting of the receiver. As all doppler users quickly learn, your bearings on a given signal are best when you are driving in an area that is higher than surrounding terrain and away from buildings and other reflectors of VHF signals. Elevated freeways are great for bearing-taking; canyons are bad.

Similarly, you will always get better bearings on signal sources that are high and in the clear. For example, it seems that no matter where I drive, I get steady bearings on repeaters atop Mount Baldy. On the other hand, low-level repeaters and base stations around Fullerton, while much closer, give wandering or fluttery bearings even when I am mobiling high and in the clear. The low-level stations have many nearby objects to provide signal reflections. This creates apparent multiple sources with composite phase variations that the doppler has difficulty resolving. (Hiders take note.)

Not For Strong Signals Only

Doppler sets are often perceived as inferior to beams and quads for VHF RDF because of the low gain of quarter-wavelength whips and loss in the switcher. But some hams have found that a well-built doppler can track signals that don't show on the S-meter. They may not even be intelligible.

Tom Lewis AB5CK tells of just such an instance. "Someone called me about a signal that was QRMing a major repeater. I went out with the doppler and I couldn't hear a thing. They said it was definitely there and had been been on for three days. I was thinking I would have to get the beam out, but I tried opening the squelch first. I heard a DF whine in the audio and the LEDs were jumping all over the place. They 'leaned' in one direction, so I went that way. The QRM signal began coming in stronger and stronger and eventually I found it. So the Roanoke Doppler will track signals below the noise floor."

	VHF–High	UHF–Low	UHF–Mid
Design center (MHz)	146	224	440
Frequency range (MHz)	121–174	185–270	370–530
Whip length (inches)	19.25	12	6
Whip spacing (inches)	18	12	6
C101–C109 (picofarads)	680	470	220
L101–L105 (microhenries)	1.5	1.0	.47
Homemade choke turns	24	20	12
JW Miller choke	4604	4602	9230–12

Figure 1. Array and component data for the new Roanoke Doppler Switcher for three popular bands. You can easily scale the array for other VHF/UHF ranges.

Jerry Boyd WB8WFK of Albuquerque, New Mexico, made a similar discovery. "I found with the Roanoke that when the signal is weak and you can barely hear it, it will still track. I added a buffer in my 2 meter FM radio to tap out the 10.7 MHz IF. Using a battery-powered shortwave SSB receiver connected to this tap, I can hear the carriers when all I can hear on the FM detector is noise. During tests using transmitters at known locations, it was tracking these weak signals. There was some bearing error, but it would at least steer you in the correct quadrant."

Nowadays, when tracking a very weak signal, Jerry uses the SSB receiver on the IF to tell if a carrier is present. If so, he opens the squelch to attempt to get a bearing. He sets the damping control at maximum so noise and modulation will have minimum effect on the readout.

Finale

Grab a red pencil and make a couple of corrections to the switcher schematic on page 73 of the April issue. The PIN diodes at the common point ends of the four coax lines are correctly designated D101 through D104. The diodes at the whip ends should be D105 through D108.

I'm interested to know of your successes with the Roanoke Doppler and its new antenna set. For that matter, I want to hear all about transmitter hunting activities in your area. Action photos are always welcome, too. Send postal mail to the address above and E-mail to my new Internet address (HomingIn@aol.com) or to CompuServe (75236,2165).

HAM HELP

Number 16 on your Feedback card

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2" x 11") sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

WANTED: Information about FAIRCHILD Oscilloscope Module 74-94A, and FAIRCHILD Main Frame 765. I need the schematic and service manuals. *Blase J. Furfaro W7ISJ, 10332 Camino De La Placita, Tucson AZ 85748. Tel. (602) 886-3087.*

NEEDED: Any information, plans, schematics, etc. for a HALLICRAFTERS Model SX-62 shortwave and broadcast bands Receiver. I will gladly pay for any copies and postage for any of the above. *Lyle L. Goheen N7VUE, 2038 Palm St. #508, Las Vegas NV 89104.*

My physiology laboratory is studying the behaviour of the three-toed sloth (Bradypus Variegatus), using short range (50m) bioteletry. Could any fellow radio amateur help me to find a source (or donate) a good quality broadband receiver covering 145-160 MHz FM, and a small motor drive able to rotate a mini video camera in X-Y axis? *Carlos peres da Costa PY7-CPC, Depto. Fisilogia e Farmacologia. C.C.B., Universidade Federal de Pernambuco, RECIFE PE 50 .970-090, Brazil, South America.*

I need the assembly and operating manuals for the HEATHKIT Oscilloscope, model IOD-4540. I will pay for copies and mailing costs. *Ken KF8BC, 7716 Oceola Lane, West Chester OH 45069. Tel. (513) 779-4148.*

NEEDED: Copy of the manual for KENWOOD TMZ01A 2 meter Mobile Radio. TNX. *Art Coulombe W7HGK, 21 Yakima St., Walla Walla WA 99362.*

VIZ MASTER VOLTOHMYST. MODEL WV-510A. Strong resemblance to the early 70s RCA Senior VoltOhmyst housed in a blue die cast case. Could really use a schematic, an operators' manual would be a plus. Copy costs and/or shipping costs will be covered. *John Pakusich WB6KVF, 720 Walker Ave. #6, San Pedro CA 90731.*

WANTED: *73 Amateur Radio* (April, 1967) with Alfred E. Neuman cover. Will pay top $$$. Multiple copies wanted. Please contact *Michael Lemer, 32862 Springside Lane, Solon OH 44139. Tel. (216) 349-3776.*

I am eleven years old and am starting an amateur radio call license plate collection. If you have changed your callsign and have a now-out-of-date license plate, please write to me. *Michael Spenn, Box 33216, San Antonio TX 78265.*

I am looking for manuals and schematics for: CENTRAL ELECTRONICS Model MM-2 "Multi-Phase RF Analyzer;" HEATHKIT HD-1422 Antenna Noise Bridge; JACKSON Model 640 "Test (RF) Oscillator;" and HEATHKIT HD-1 Harmonic Distortion Analyzer. I will gladly pay costs of copying and postage. *John Sehring WB2EOG, P.O. Box 373, Baker MT 59313. Tel. (406) 778-2452.*

I would like to get in contact with anyone receiving WEFAX signals direct on 1691 MHz, within a 60 mile radius of South Bend IN. *Jim Kocsis WA9PYH, 2217 Hidden Oaks, South Bend IN 46628. Tel. (219) 277-1786.*

I am looking for manuals and schematics for: 1) CENTRAL ELECTRONICS "Multi-Phase RF Analyzer," 2) HEATHKIT HD-1422 Antenna Noise Bridge, 3) JACKSON Model 640 "Test [RF] Oscillator," and 4) HEATHKIT HD-1 Harmonic Distortion Analyzer. I will gladly pay costs of copying, and postage. *John Sehring WB2EOG, P.O. Box 373, Baker MT 59313. Tel. (406) 778-2452.*

I need the assembly and operating manuals for the HEATHKIT oscilloscope Model IOD-4540. I will pay for copies and postage. *Ken KF8BC, 7716 Oceola Ln., West Chester OH 45069. Tel. (513) 779-4148.*

I have a printed circuit board 3 3/4" square, with the letters "WD5HSN," and some other parts for an alarm system. I am looking for a schematic, or any other information about this system. Thank you. *Judson White WA2PMH, 50 N. Greenwood Ave., Hopewell NJ 08525.*

WANTED: Manual or partial copy for HEATHKIT Models SB313, SB300 and SB400. *Robert Schlegel N7BH, 2302 286 St. East, Roy WA 98580.*

NEEDED: Contact with SSTV operators using (AEA) AVT terminal with AMIGA computers. I require assistance with various procedures and programs. Many thanks. *H. Rothenberg ZS6JH, P.O. Box 84053, Greenside 2034, South Africa;* or FAX: *27-11-646-8436.*

Could anyone supply me with a 5-pin short wave coil salvaged from a late 1950s KNIGHT Kit "Ocean Hopper" regenerative Receiver Kit? I prefer junk box donations but will gladly purchase a whole unit if it includes the cabinet and all five coils. *Al Cikas KA9GDL, 412 Radford Dr., Sherman IL 62684.* TNX.

Number 17 on your Feedback card

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

SWR Primer for VHF through Microwave, Part 2

Last month I covered the application and comparison of an SWR measurement system as it applied to both VHF and the microwave bands. In it I discussed our group's efforts to make meaningful measurements with simple equipment in the low frequency to 10 GHz microwave bands. This month I want to cover other aspects of SWR and circuit testing, describing other devices to aid our function tests.

Some of these new devices rely on magnetic action to do their jobs. This is different from the directional coupler described last month, which uses "static," or non-active, lumped components. These microwave magnetic widgets include magnetic isolators and magnetic circulators. These are basically inactive in that they do not require power but rely on a high intense magnetic field set up by permanent magnetics on the devices.

I have received many inquiries on these devices and it's a good time to include them in a short discussion. These devices, along with other microwave bits and pieces, can be picked up via surplus, or at many of the swap meet sources. I imagine Dayton would be an excellent source for this material if you are interested; it's the largest swap meet of all. I have never been there but have seen photos of the swap meet area, and it's huge. I plan to go there when I win the California Lottery. Well, then, let's get some test configurations set up and put to use some of these many different microwave widgets.

The Necessary Test Equipment

In each example I want to cover both the setup and arrangement of equipment for specific tests. All of the test configurations will use equipment that I have obtained via surplus and swap meet sources. This equipment is not the latest, as most of it was manufactured in the mid '60s through the '80s. I have to admit that it has taken a lot of scrounging over the years to pick up this equipment, but for want of a good microwave test bench nothing else would suffice.

What do you need? In the microwave world you need several different pieces of equipment: power meters, frequency counters, detectors, signal generators, sweep oscillators, frequency standards and noise figure test sets. These are the major league players. Life without some of them can be frustrating when you delve into this edge of the spectrum. If I were to recommend a single piece of test equipment, it would be the power meter. Power meters are able to detect very small changes in forward or reflection measurements.

The next most asked question is, "What kind of power meter do I recommend?" Well, there are three possibilities: General Microwave, Hewlett Packard and Brand X. I use the HP-431 power meter, while Kerry N6IZW uses the GM meters. Both work equally well and are just as accurate for our purposes. Our individual choices were not a matter of preference but rather what we each picked up in the beginning. When I find GM equipment I give it to Kerry, and in return he does the same for me with HP equipment.

Now, the big question: How do we test or determine what is an acceptable level of performance for other devices we will use with the power meter for tests? The difference is the return loss of the item under test, or simply the SWR of the individual device. If you measure return loss and the difference in power levels from forward to reflected is in the 10 to 14 dBm range, your device or SWR meter has a problem at this frequency. It's the same thing as saying it has power SWR. The dB readings indicate an SWR ratio ranging between 1.6-3.0 to 1. Such readings indicate a very poor level of performance. If the difference is between 20 to 25 dBm, the SWR meter has an internal SWR of between 1.2 and 1.1 to 1, which is quite acceptable for most uses. Some of the commercial surplus microwave test equipment that I have tested exhibited return loss in excess of 25 dBm, a very good SWR.

Why, then, do these microwave parts cost so much when new? It's not that the basic equipment is that expensive to manufacture; it's the high level of testing that goes on to ensure that the device is well matched over its intended working frequency range. Labor cost to calibrate microwave devices to specifications is the big addition to the equipment's price tag, not the equipment itself. Simply stated, return loss in the 25-some dBm range is quite good and relates to an SWR reading of nearly 1.1 to 1, which leaves us feeling warm and cozy.

Now the tough part: At minimum, what other devices coupled with our power meter do we require to perform these tests? A suitable start would be to collect a variety of both coaxial and waveguide directional couplers and circulators. Don't let the word "microwave" disturb you when you go looking for a suitable power meter. Almost all power meters will function accurately over a frequency range of 10 MHz to over 12 GHz. Just remember, microwave power meters are not calibrated in "watts," but rather in "milliwatts," and require suitable attenuators to protect the power meter when reading powers that are unknown or much higher than the +10 dBm rating of most heads.

With suitable attenuators a high power can be very accurately measured on these microwave power meters. For example, if I wish to measure my 2 meter HT (approximately 2 watts) on a VHF power meter, like a Bird 67 wattmeter, I read about 2.1 watts. The difference between 2 watts and 2.1 watts is a meter needle width and subject to parallax interpretations. If I make the same test on an HP-431 power meter (maximum power to the meter head: +10 dBm) with a 30 dB attenuator (coaxial), I can make a very accurate power measurement.

Let's take a close look at what is going on. Two watts of power is the equivalent in dB to 33 dB of power (see Figure 3 for details). Under this

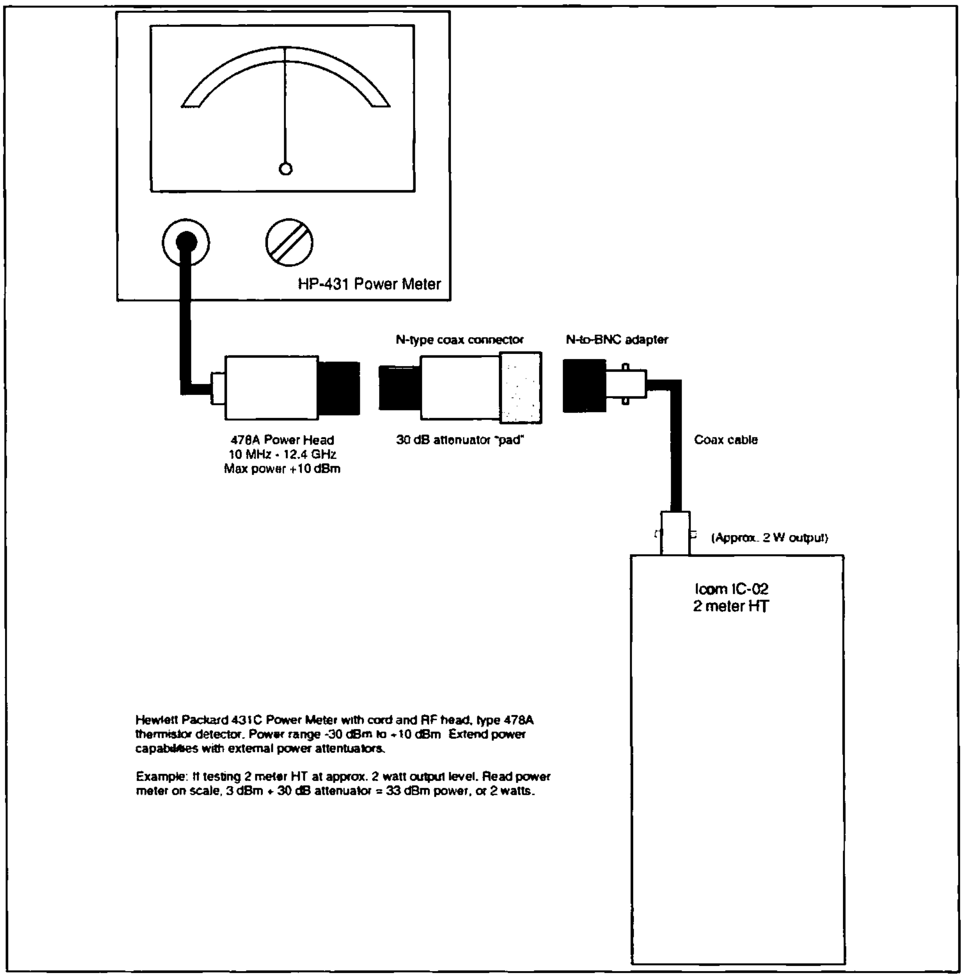


Figure 1. Sample setup HP-431 microwave power measurements.

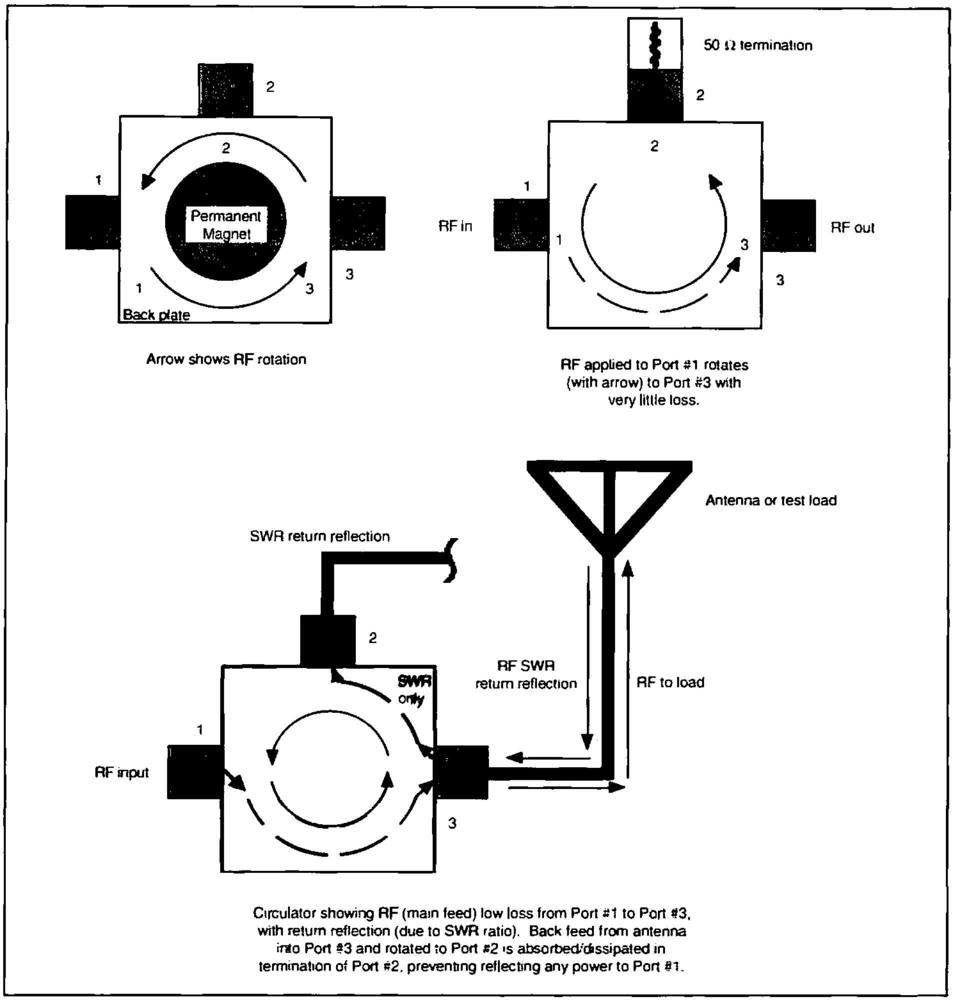


Figure 2. SWR power in a circulator, magnetic rotation or circulation of RF power in a magnetic circulator.

lest I have a meter scale that is almost 10 times in length to make an accurate determination and an actual power meter reading of 2.24 watts of power. Now, in reality, this slight difference will not amount to a hill of beans at 2 meters. However, at microwave frequencies this power increase is very significant and can be the difference between fine-tuning an amplifier or not obtaining good results by looking for bigger increases. Microwave peaking is accomplished by fine-tuning and careful adjustment. Know the capability of your metering system.

Circulators

Up to this point we have confined our demonstrations to directional couplers. There are other devices thai work somewhat in the same manner: circulators and three-port circulators. Circulators and three-port circulators are all the same, it's just that some only bring out two ports and internally terminate the third port. These devices differ from directional couplers in that they don't operate by a coupling action, but rather by a magnetic rotation of RF within the circulator. The name is derived from the magnetic function causing the RF power applied to an input port to be rotated about the device. The RF rotates in concert with the magnetic lines of force in a circular motion through the device, hence the name, circulator.

The device consists of three ports and a back plate (or four ports if you prefer, but in reality the back plate is never counted as a port because it is always internal). Sometimes the reflection port is permanently terminated in 50 ohms. In use, RF power applied to port 1 is reflected off the back plate and feeds port 3 with all RF received from port 1, less minimal internal losses. Let's assume port 3 is an antenna. If the antenna is a good match, very little RF is reflected back into port 3.

I assure you there will be RF reflected back into port 3, as only a perfect match will cancel out reflections. Perfect is desirable but not attainable; a compromise is more normal in the imperfect world due to the SWR ratio or less-than-perfect match at the load/antenna port. The rotation of reflected RF is the same as before and would continue, except it is dissipated in the port 2 load by a 50-ohm resistor. In some cases this termination resistor is coaxially connected and removable. If you have a removable termination at port 2 you can connect a power meter in its place and measure the reflection return power at port 2. See Figure 2 for details. In essence, you don't need to know what the SWR ratio is—you just adjust the load for minimum reading at port 2.

What, then, is the difference between a magnetic circulator and a magnetic isolator? A magnetic isolator is similar in action, but is used only as a two-port device. It is usually used only as a waveguide component and has a very large permanent magnet attached to a short section of waveguide. The action of the large magnetic field allows RF to flow in only one direction with a minimum of RF loss. In the reverse direction it has maximum loss, with the RF trying to flow backwards through the intense magnetic field. Magnetic isolators are used to prevent any reflected RF from reaching the RF source and upsetting it. They are similar to circulators but do not have any means of dissipating excess reflected power. Isolators are just that—big, bulky devices providing isolation between devices by restricting RF to flow in one direction only. See Figure 6 for details.

All devices described up to now are suitable for making SWR measurements, or for use as an aid in making RF measurements for other setups and applications. The most accurate device has yet to be described. It is called the slotted line.

The Slotted Line

The most accurate measurement device used to make SWR measurements or other power measurements in a transmission medium is the "slotted line." (See Figure 4.) This device will make very accurate SWR readings along a slot or opening in the transmission line into which a probe is inserted to sample RF along a transverse path. A modulated RF source is used for this measurement to drive the input of the slotted line. The test device (an antenna, in this case) is connected to the output of the slotted line. Measurements are made when the probe (inserted into the slot) is moved about the length of the slot and readings are noted on a specially-built SWR meter. This meter is actually an audio frequency voltmeter with a special filter of very narrow bandwidth at 1 kHz. This meter connects to a detector diode that is part of, or is coaxially attached to, the probe on the slotted line.

The SWR meter used in this case is nothing more than a selective 1 kHz highly-calibrated audio detector that is used to detect the audio modulation envelope on the RF envelope. Measurements are made at maximum and minimum readings on the SWR meter, and the standing wave ratio (SWR) is read on a scale of the meter (1 kHz modulation for this test is industry standard). In a nearly perfect termination, the forward and reflected RF products in the slotted line will have a power reference that is nearly unchanged. As such, the peak value of the modulated RF envelope will remain nearly unchanged as readings are made with the probe moving along the slot. Example: If all the power is absorbed in the load (the antenna, in this example), there will be a *very low* SWR, 1.1 to 1 or less.

In actuality, there will be a maximum and a minimum reading on the SWR meter, but the difference be-

dBm vs. Power (Watts)

0 dBm	1 mW
5 dBm	3.16 mW
10 dBm	10 mW
15 dBm	31.6 mW
20 dBm	100 mW
25 dBm	316 mW
30 dBm	1.000 watt
35 dBm	3.160 watt
40 dBm	10.000 watt
45 dBm	31.600 watt
50 dBm	100.000 watt

Figure 3. Chart for RF power in watts and conversion to power in dB equivalent. For each power increase in 3 dB steps, actual power in watts doubles.

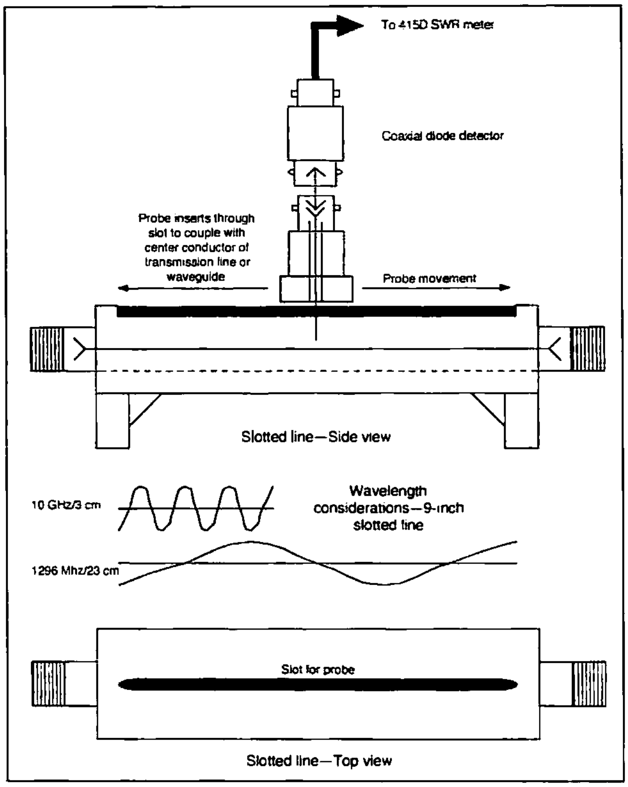


Figure 4. Slotted line in respect to wavelength considerations. In general, small components are good for very high microwave frequencies, and large components are suitable for much lower frequencies.

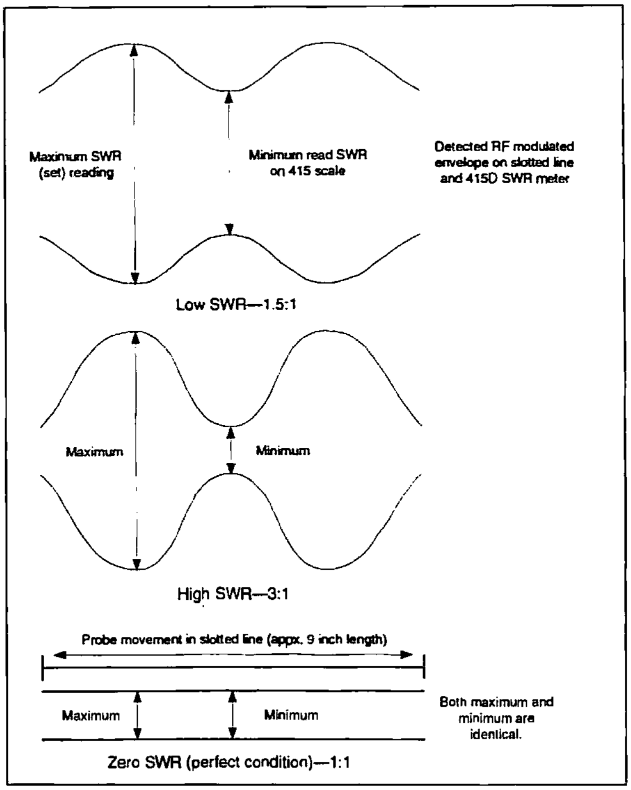


Figure 5. SWR, showing modulated RF envelope vs. slotted line probe movement.

tween these two readings will be very slight, indicating a very low SWR reading, or a nearly perfect match. As the difference between the readings gets bigger, the SWR value increases as well. The value of using this system is that it is capable of showing very fine increments of SWR readings at almost any frequency where you have a slotted line carriage to test from.

The principle lor all frequencies is the same: If the SWR of the antenna is not a good match, part of the power applied to the antenna will be reflected back to the source. The reflected RF will cause a minimum and maximum RF in the slotted line due to different phase relationships and other factors. This is what SWR is all about, without getting really technical. It's sufficient to say that in the transmission line or slotted line there will be minimum RF at some point and maximum RF at a point further down the slotted line. The actual SWR will be a ratio of the RF maximum-to-minimum readings.

We don't want to measure the RF power in this case. Rather, the modulation on the RF wave (the 1 kHz modulation) is detected in the HP-415 D SWR meter (the 1 kHz receiver in this case). SWR readings are accurate to extremely small increments using this setup. The SWR readings are displayed directly on the face of the HP-415 meter. In use, we calibrate this meter for maximum peak RF in the slotted line and "set" a reference point in the HP-415, then move the detector probe to a minimum in the slotted line and read the SWR directly from the face of the HP-415 SWR meter (the 1 kHz receiver). It's very simple, but you have to have the tools to get the job done.

At lower frequencies, the modulation from a precise 1 kHz source can be used to modulate a signal generator in the 500-to-several-GHz range. The HP-415 SWR meter does not care where the RF or modulation comes from, as long as it can recover enough detected RF with associated 1 kHz modulation to allow calibration of the HP-415. A suitable much longer slotted line would have to be used at these lower frequencies. At 500 MHz, a slotted coaxial line would be about 8 to 10 inches long for minimum results.

Using a Modulator

Modulating an RF signal at the high microwave frequencies can be difficult, but with a device called a "PIN modulator" the job is quite easy. A PIN modulator is like the PIN diode switch found in most newer VHF transceivers, used to switch from receive to transmit on the RF coaxial feed. In the modulator application, 1 kHz is applied to the diodes, rather than switching DC bias. The diodes turn on and off at a 1 kHz rate, in effect causing RF to be modulated by the 1 kHz bias. In my test setup for 10 GHz I use a surplus HP-8734A PIN modulator driven by a 10-mW Gunn source set to the frequency of interest. This setup is then fed to the waveguide slotted line, which attaches to the antenna or device under test (DUT, for short).

To set calibration on this type of system, it's only necessary to bring the meter to an RF maximum point on the slotted line and set a zero reference, then reposition the slotted line to an RF minimum and read the detected modulation and the corresponding SWR off the meter face. At 10 GHz, for example, it is possible with this setup to make meaningful SWR readings like 1.02 to 1. It's quite an accurate device. An analogy at HF, 3 to 30 MHz, would be to have the school football field laid out with a similar slotted line. As you can see, this is not practical due to the very long wavelength at these frequencies. The slotted line is useful at 500 MHz and above due to the same wavelength size considerations.

For a slotted line to be useful, it must be long enough to contain a full half-wavelength at minimum. Lengths at 1296 MHz and above would not be a problem as a full wavelength at 1296 MHz is 23 cm, or about nine inches long. Half of that is 4.5 inches—well within the six-inch slotted coaxial line I am using. However, at 450 MHz a half wavelength is just over 13 inches and not usable on this short six-inch slotted line. See Figure 4 for details.

Well, that's it for this month. As always, I will be glad to answer questions concerning this and other related microwave VHF/UHF topics. Please send an SASE for a prompt reply. 73 Chuck WB6IGP.

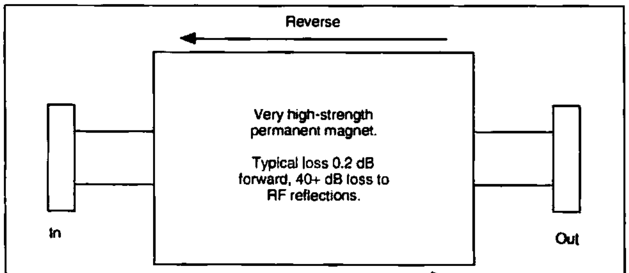


Figure 6. Waveguide isolator. Typical very low loss in one direction only, used to isolate oscillators and other RF sources from effects of SWR.

Number 18 on your Feedback card

ATV

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Rocket-Powered ATV

In early April, I attended a high power rocketry event sponsored by the Tripoli Rocketry Association. Located at a site called the Spears Range, near Manchester, Tennessee, this weekend event drew rocket enthusiasts from several states and featured moderate to very large rockets that flew nearly continuously during each day from more than nine launch pads. These are not your typical hobby shop kind of model rocket—some really are small sounding rockets!

There were dozens of flights (some to over 10,000 feet) and some very spectacular failures! One flight did three somersaults and buried its nosecone into the ground just in front of the viewing area, with the motor still firing. The crowd had a good laugh when the parachute popped out!

While most of the rockets used a solid fuel engine, there were a few that used a different kind of arrangement. Tim Pickens, from Madison, Alabama, brought out his 11-foot-tall, 55-pound steam-powered rocket (that's right—*steam*). He hooked it up to an AC generator and literally boiled the water in the rocket's tank until it reached the proper pressure. He opened the valve in his steam engine and the rocket headed skyward with an amazing cascade of hissing steam trailing behind. While not the most efficient propellant, it is very inexpensive, and the rocket reached about 500 feet in altitude.

Photo A. Left to right: Andrew Mossberg KE4RKZ, Tom Bales KE4SYS, Ted Slack KE4SEM, Korey Kline, Kevin Smith N4SMZ and Adam Germann prepare to fly the ATV rocket

I also ran across another propulsion system that was offered by a group called Environmental Aerosciences. Their system is the Hypertek, and is a hybrid rocket engine consisting of nitrous oxide (laughing gas) and thermoplastic. Their ingenious and compact system mounts in a standard rocket motor mount and consists of a pressurized cylinder that contains the nitrous oxide and a disposable plastic tube with an embedded nozzle that is actually the fuel and combustion chamber. This provides a great deal of thrust (comparable to a "J-motor"), but is very inexpensive to fly. All it takes to reload the motor is to replace the thermoplastic fuel grain, fill the nitrous oxide tank while on the pad, and fly again. Their group flew 10 times during the two-day event.

It turned out that most of their group were hams, and they had driven all the way up from Miami, Florida! In their group were Kevin Smith N4SMZ, Ted Slack KE4SEM, Tom Bales KE4SYS, Andrew Mossberg KE4RKZ and Korey Kline. As I observed them prepping another rocket, I asked them if they had had a chance to fly any ham payloads yet in their hybrid rockets. Tom KE4SYS showed me a GPS payload that they had intended to fly, but a glitch in the GPS receiver kept the package on the ground. It was nicely constructed and looked like it could withstand a nuclear blast!

On the second day of the meet, I brought along my mini-ATV system that I've used as part of the Hat-Cam and have flown on tethered balloons and kites many times. It was definitely *not* able to withstand any high-G impacts or nuclear blasts and was just loosely packaged into a piece of styrofoam. I guess I must've been standing too close to the nitrous oxide tank when they suggested that I fly my camera on the *outside* of the next rocket they were preparing, and I gleefully agreed to the lunacy!

"I guess I must've been standing too close to the nitrous oxide tank when they suggested that I fly my camera on the outside of the next rocket they were preparing, and I gleefully agreed to the lunacy!"

Risky Rocket TV

The ATV system for this rocket consisted of an MVP5 b/w TV camera (available from Micro Video Products) and a postage-stamp-sized micro-ATV transmitter (see the July '91 issue of *73*, page 8, for details). The camera and the transmitter were powered by separate 9-volt batteries. The antenna consisted of a quarter-wave BNC mounted whip.

We used a LOC/Precision Magnum rocket, built by Ted KE4SEM, with an 18-inch-long payload section. This section has a diameter of around 5.5 inches. The micro-ATV transmitter, whip antenna, 9-volt batteries and a lot of bubble wrap were stuffed into the payload section.

The MVP5 camera was mounted to the outside of the payload section with lots of electrical and duct tape. Most other rocket ATV systems I have seen involve mounting a mirror on the outside of the rocket or just sticking the lens out through a hole in the payload wall. Unfortunately, the mirror system inverts the video image, so sticking the whole TV camera outside looking down at the fins provides an excellent view. This camera is well-suited to this kind of application due to its very small size (approximately 1" on a side) and

Photo B. Korey Kline puts the finishing touches to the duct tape "cowling" holding the TV camera to the outside of the rocket as Adam Germann braces the fuselage

its light weight (just over 2.5 ounces). I would recommend that in a permanent installation you build a small cowling to cover the camera and secure it in place with a 1/4-20 bolt if you ever want to see your camera again in one piece.

After a bit of last-minute adjustment to the aerodynamics of the duct tape "cowling," the Magnum was ready to fly.

A Wild Ride

The suspense was building as the rocket was transported to the pad. We had a beautiful snow-free picture on the TV set in the RV. To eliminate sync loss (and because we had no other way to record the video), we elected to record the image right off of the TV screen. In the subdued lighting of the van, this worked very well indeed. The receive antenna consisted of a hand-held two-element quad pointed at the rocket during the flight.

The hybrid engine was filled up with nitrous oxide, the pad was cleared, and then ignition! The rocket screamed off of the pad while providing us all with spectacular TV images of the flaming Hypertek engine and the smoking exhaust trail as the field got smaller and smaller. Everyone cheered as the parachute deployed at around 1,500 feet and flew by the camera. Kevin N4SMZ made the comment that it looked just like a NASA flight. The rocket gently descended back to the field and the ATV image showed an extreme close-up view of a cow as the payload landed in the middle of the herd.

Even with the low power (80 milliwatt) transmitter, we received a snow-free image during the majority of the flight, with only a few fades at apogee. To top it all off, my TV camera survived the flight totally unscratched!

Although this was a fairly heavy rocket capable of lifting much heavier payloads, you could probably fly this ATV system in a much smaller rocket with good results.

Rocket System Parts List

MVP5 camera:
Micro Video Products
1334 So. Shawnee Dr.
Santa Ana CA 92704
(800) 473-0538
(714) 957-9268

Micro-ATV transmitter:
Assembled
P.C. Electronics
2522 Paxson Lane
Arcadia CA 91007-8537
(818) 447-4565
Kit
Elktronics
12536 T.R. 77
Findlay OH 45840
(419) 422-8206

Magnum rocket:
LOC/Precision, Inc.
Box 221
Macedonia OH 44056
(216) 467-4514

Hypertek Hybrid HiPower rocket engine:
Environmental Aerosciences
18955 South West 168 Street
Miami FL 33187-1112
(305) 234-5700

QRP

Number 19 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Field Day

Ah yes, June and the smell of CW floating though the air. Egads, it's Field Day time once again.

Although I really don't like contests, I do enjoy Field Day. I use it as an extended field test for new rigs and antennas. There are signals all over the place, just waiting for you to snap them up.

It everything goes as planned, I will be using the home-brew rig described last month for this year's Field Day. With all the intermod, crud, junk and other critters living on the ham bands during Field Day, I'm sure to find any bugs in the receiver.

Antennas

However, before I connect the rig to the battery, we need a good Field Day antenna. My all-time favorite is the center-fed Zepp feed with 300-ohm TV twin lead. Each side of the Zepp is 65 feet long. This is more than enough to cover 80-75 meters, as well as 40 and 20 meters. Of course, you'll need an antenna tuner to get the antenna to resonance at the frequency you're working on. I use an old beat-up Ten-Tec antenna tuner with balanced-line output. This tuner does not have an SWR meter, so an external meter must be employed, unless your rig has one built in. One of the many MFJ antenna tuners would be ideal, too. They're much smaller than the Ten-Tec unit I've been using.

Before the Field Day activity starts, I tune the antenna to the portion of the band I plan on using, and make up a cheat sheet for quick resetting. This also gives me some idea of what the radiation pattern of the antenna is before the contest gets under way.

If there is both time and space, a second Zepp at right angles to the first one is a grand idea. This way you can select between the two antennas and between the resulting different radiation patterns they produce. A good grade of knife switch makes switching from one twin lead feed to the other guilt-free.

Of course, it goes without saying, the higher the antenna, the better it will perform. I use thin kite cord to hold up the two ends of the dipole. I prefer the cotton line, but will use nylon if need be. The cotton will degrade if pieces of it are accidently left behind. I've used cotton twine several times and it's proved equally useful.

One problem with the twin-lead feed is keeping it from touching objects such as tree limbs and camper rooftops. By using the cotton twine, I can usually make up stand-offs to support the twin lead away from such things. Needless to say, never leave the excess twin lead laying on the ground. Cut off the excess instead ol leaving it in a ball on the ground. When you're only running 2 watts, you sure don't need your RF going into the ground.

Power Supplies

For power, I use the best of two worlds: solar and battery storage. I want plenty of juice, so I usually bring along a 25-amp/hour battery and a 10-watt Solarex MSX-10 panel, although I've been known to use a higher-power solar panel of up to 75 watts peak power. With the 10-watt solar panel and the 25-amp/hour battery there is no need for a solar charge controller.

I don't really get my jollies by toting around 60 pounds of lead and acid, so I use a smaller gelled battery. The one I find provides all the power necessary for the 24-hour contest is the type U1 wheelchair battery. Most Sears automotive stores stock this guy. If not, any of the larger battery dealers will have it. Just ask for the 25-amp/hour wheelchair battery, and they'll know exactly what you mean. It will set you back about 60 bucks, but is well worth it. Check the surplus outlets; I've seen the exact same battery for $25 brand-new with warranty.

I've also used a set of two 6-volt gelled batteries. You can pick these guys up at any Toys 'R Us store. They're used in the small electric-powered cars and trucks kids ride in. They're rated at 9 amps/hour, which is more than ample for a QRP FD. With the electrolytic sealed, the battery can be placed in any position, even upside down, without the worry of acid spills on your logbook.

Although not mentioned, it is an absolute must to use fused power cords when running with a battery of that capacity. A short circuit will mean instant meltdown. I prefer to use magnetic circuit breakers instead of fuses. They're extremely fast, and you can reset them after you fix whatever caused it to trip in the first place. I'm sure you can get the magnetic circuit breakers from several different sources, but I use the 9-amp breaker supplied by Ten-Tec. It's the unit used for the Argosy when running from a battery source. It's not cheap, about $20, but it's worth every bit that much when something goes wrong. I'll keep an eye out on the surplus market for these breakers, and if I can find them at a reasonable price I'll let you know.

Computer Logging

Now that we have the rig, the antenna and the power source, how about logging those contacts on a computer this year? I use a program for MS-DOS I picked up as shareware. It's fast, easy to use, and will run on my old Tandy 1100 Field Day laptop. I have yet to find a program for my Macintosh Powerbook that will do all the stuff this one will do. But, I'm still looking.

During the last several years, I've been very laid back when it came to keeping track of the contacts I make during Field Day. In fact, I've been known to not even write any of them down on paper! Since the exchange is so simple, there's no need to get upset if you miss a report or two. Of course, I've not turned in a log to the ARRL in about six years, so I don't need to worry about the finer details of Field Day logging. I will bring along the computer this year for some serious logging.

The old Tandy won't run much over two hours with its internal battery pack, so a patch cord and series regulator tap power from the 24-amp/hour battery. In the "I really don't need to carry this along with me" category, I bring along an extended voltmeter to monitor the battery during the contest. I've never been able to draw the battery down to a discharge state over the 24-hour period.

While the computer is grand for logging, it isn't good for sending CW. Instead, I prefer the old hand-operated electronic key and paddle. It's much faster to send CW with the paddles and keyer than to type it out on the keyboard, at least that is what I think. I use the Super CMOS Keyer as appeared in *QST* several years ago. You can still get most of the parts for this memory keyer. I use the internal battery to operate the keyer, making for one less cable to worry about.

All the equipment I have mentioned only takes up about one square foot of space. Although the battery is a bit heavy, it's easy to lug the setup deep into the woods for some real serious Field Day action. My plan of action for Field Day is rather simple: have fun, have fun, and have fun.

RTTY LOOP

Number 20 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

Somehow, I have the incredible need to tell you that this column marks the end of the 18th year of "RTTY Loop." Eighteen years! To put that in perspective, my son, who was an infant when the first "RTTY Loop" was published, can now vote. Frightening, isn't it? And you don't even know my son.

Anyway, my mailbox is stuffed with all your comments, questions, and suggestions. Miles L. Clouston N8VJM/1 sends along, via E-mail:

BayCom Demodulator

"I was particularly pleased to see that the Software Series is now up to seven volumes. *[It's now 10.]* Now that I am becoming more equipped (from a hardware standpoint) to participate in RTTY and similar modes of communication, it would probably behoove me to have those volumes. Also, are there any plans available for a simple (quick and dirty) hardware interface (modem or just demodulator) allowing me to (at least) copy and (possibly) transmit RTTY? I know that most full-featured modems will do such a thing, but I also wonder if an Item such as the BayPac Model BP-1 (with the proper software) would support such activities. I am In the process of purchasing an IBM sub-notebook and thought that this could be a *great* setup for mobile/portable packet/RTTY operation. I already (about 18 months ago) constructed an end-led telescoping halfwave 2m antenna (matched 'J-pole' style, with 300-ohm ribbon) that could be (and is) installed in a rugged Samsonite briefcase. For my next trick, I'll use an aluminum case and possibly stub matching for the antenna(s). Build In gel cells, a charging system, and maybe a small amp (possibly a dual system for data and voice), and I would be ready to roll for anything from tun to events to disasters."

Well, Miles, I appreciated the notes, and information on the software series is at the end of the column. As to the demodulator, there are several little schemes around to simply turn tones into pulses, and the ones that have accompanied the BayCom program may well be the simplest. Figure 1 Is one such diagram. This little demodulator uses only one integrated circuit, and may be just what you're looking for. Good luck, and let me hear how you are doing.

Teletype Corp. Manuals

Another E-mail'er Is Jim Cooper W2JC, who writes:

"I see in your column that you have been listing folks trying to find decent homes for Teletype Corporation manuals and machines.

"I have quite a supply of original Teletype Corp. manuals for Model 28, 32, 15 and 14 (ha ha!) which I just hate to throw away and I'm sure some historical junkie would die to have them (but how to find somebody like I was 20 years ago?); I actually have an almost complete set of every Teletype Corporation manual, along with many, many duplicates of certain ones. If anyone wants them for nostalgic or historical purposes, an SASE or an E-mail would do—I'm past the point of ever expecting to get any money back on them!

" 'I have quite a supply of original Teletype Corp. manuals for Model 28, 32, 15 and 14 which I just hate to throw away and I'm sure some historical junkie would die to have them.' "

"Also, I still have several types of mechanical teleprinters—Kleinschmidts, M28, etc. I have one Model 28 ASR set that has just about every mod kit Teletype made installed in it! I just hate the thought of It going to the scrap steel pile. Maybe someone reading your column knows of a school club or electronics class that would want it for demo purposes or whatever? Or maybe a deaf person who could use It on TDD?

"Well, if you find the space to mention them I'd appreciate It. If not, no harm. E-mail to w2jc@rltz.mordor.com, Snail mail to P.O. Box 73, Paramus NJ 07653-0073."

Now, is that an offer, or what? Actually, I would take the manuals here, if it weren't for *my* wife laying down the law, and telling me I have to get rid of some of the junque that has been accumulating in the basement for the past 20-plus years. Although, I don't know, you never know when you will need a fresh 6AU6, don't 'cha know! Hopefully, you will be able to handle the requests from the readers. Let me know how it all comes out.

Sound Blaster

Now that we've had an answered question, and an offer that many of you just can't refuse (at least until you tell your wives), how about a question for you all to answer? Here is another note, this one from Bannister Bray AH2CZ, ex-KM6ES, regarding the use of a Sound Blaster card.

"Today I took a much needed solitary lunch break away from the office. During that break I read your column, 'RTTY Loop,' In the April '95 issue of *73 Amateur Radio Today* magazine. Your article inspired this note.

"A number of months ago, while working at home, I overheard a conversation on one of the ham bands that piqued my interest. The topic of discussion was a new software program that used a Sound Blaster computer card to receive and transmit (decode and encode) RTTY, AMTOR, and PACTOR. According to the conversation, the same program and card could also be used as a Digital Signal Processor (DSP) unit for received voice audio that was far superior to the JPS NIR-10.

"Before I had a chance to break into the conversation and learn more about the program, my wife, with her impeccable timing, called me away to do something important for her. When I returned an hour later, the group had disappeared into the woodwork.

"I have heard similar conversations since then about, I assume, the same program/Sound Blaster card combination. All parties said that the combination worked quite well and was a boon to all mankind.

"The question for you is this: Do you know If such a program exists? Does it really work as described above? Who makes it? And how can one get a copy?"

Well, Bannister, after I got your note, I did a search of the various online databases, print, and other references I had, and came up blank. I am quite sure, however, that within 37 milliseconds of the publication of this issue of *73*, I will be hearing from someone who is using just such a scheme. As soon as I hear something, I'll be sure to pass it along to the readership.

FT-757GX Mod

Oh, why not one more question for the summer. Fritz N4JVP relates:

"Several years ago a British ham told me about a mod for the FT-757GX that involved a CW filter from the 101 series. This mod Involved disconnecting the MOX switch and used it to switch the CW filter In and out of line while the rig is in the LSB mode. I have unsuccessfully tried to find out more details about this modification and was wondering if you or any of your readers had heard of or tried it. I love my 757 but I would like additional filtering when I run RTTY. Any help would/will be most appreciated."

OK, folks, you're on. Anyone out there who can help Fritz? Let me know.

"RTTY Loop" Software

As suggested above, the 10-volume series of the "RTTY Loop" Software Collection remains available. To obtain a list of programs, just drop me a self-addressed, stamped envelope to the address at the top of this column, or send E-mail to one of the addresses below, and I'll send along the list forthwith. Each disk in the series can be yours by sending a 3.5-inch high density disk, $2 in US funds per disk, and a self-addressed mailer with sufficient postage to me, along with a note telling me which collection you would like.

Of course, I always welcome comments or questions. That should be evident by this month's column. My various E-mail addresses are: CompuServe 75036,2501; Delphi MarcWA3AJR; America Online MarcWA3AJR; Internet MarcWA3AJR @aol.com. Keep writing, electronically or via "snail mail." And stay tuned for next month's "RTTY Loop."

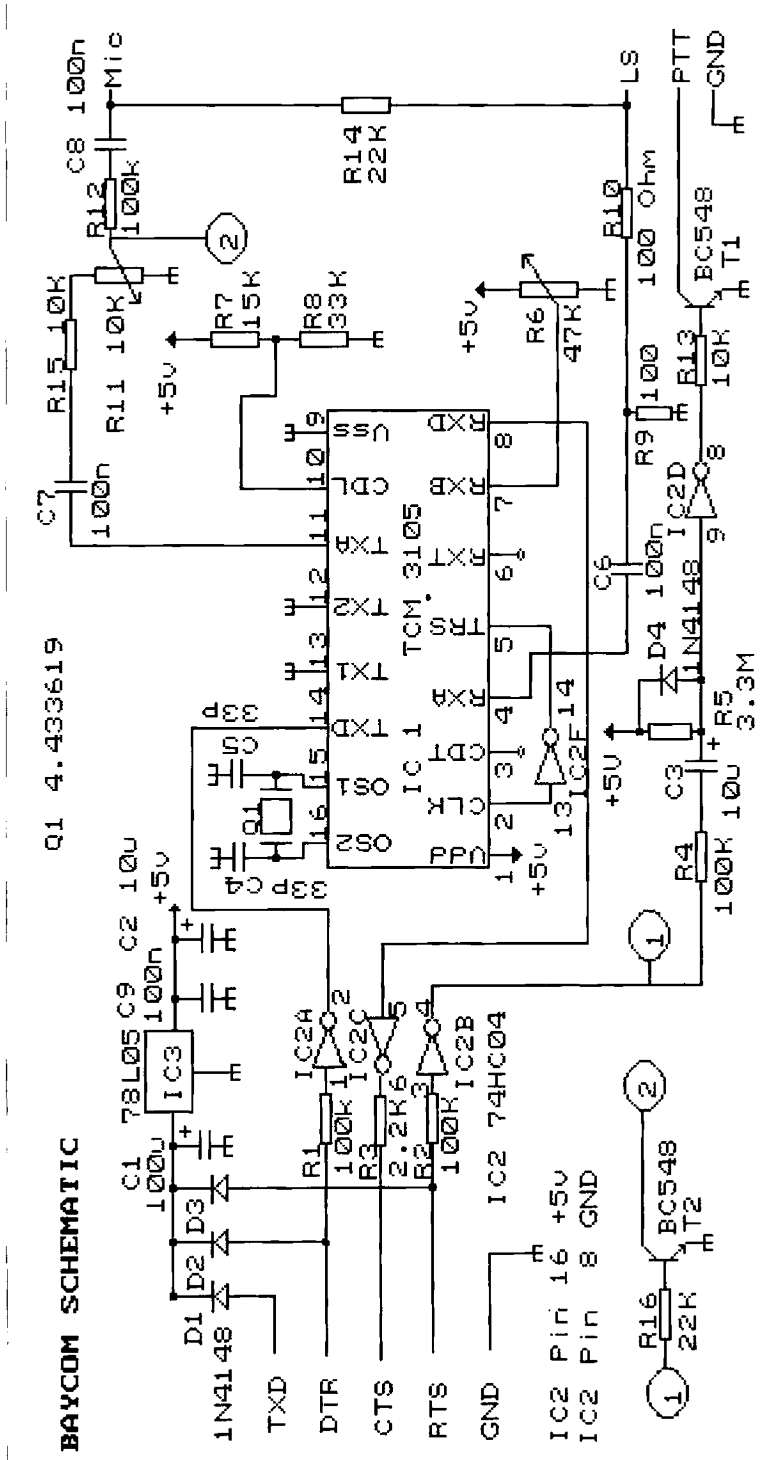


Figure 1. The schematic for the BayCom RTTY interface.

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Measuring Up

In this column, I have many limes mentioned the use of test equipment, ranging from the old-style analog voltmeter (still a useful item in this digital age) to the oscilloscope. Taking proper measurements is one of the most important skills in electronic troubleshooting, constructing or experimenting. At first thought, the process of taking measurements might seem simple: You just stick the probe on the point you wish to measure and read the results from your instrument. Sometimes it really is that easy, but there can be pitfalls. If you aren't aware of all the implications of the measurement process itself, you may find yourself getting lied to. As in the famous theorems of quantum mechanics, the process of observing can significantly alter the process being observed! So, let's fight for truth, justice and the electronic way by having a look at the procedures involved in taking measurements, and the effects your measuring instrument and technique can have on your work.

Good Ol' Voltage

Probably the most common measurement is of electromotive force, or voltage. Voltage measurements often tell you a great deal. If a voltage is completely missing, that's a big clue to a broken circuit's failure. If it's just low, that too can help you find out why. And, if it's too high, that might indicate a shorted regulator or other power supply problem.

To measure voltage, you need a reference point. Almost always, that point is the common ground of the circuit. These days, the common ground is usually negative with respect to most or all voltages in the circuit. An exception is a circuit which uses dual polarity, such as an op-amp stage. Then, your measured voltage might be positive or negative with respect to ground. It's important to remember that *everything* in a circuit is relative; there is no such thing as absolute voltage, just as there is no such thing as absolute motion or rest in space. But, by picking ground as your reference, you're standing on firm earth with respect to the rest of the circuit. So, you clip your negative lead to the chassis and off you go, right? Well, sometimes. If you're measuring fairly large DC voltages (more than a couple of hundred millivolts or so), that should work fine. Should you pick a ground point too far from the circuit being measured, you may pick up some noise, but it shouldn't be a problem at these voltage levels; compared to the DC voltage itself the noise should be so small that it doesn't introduce significant error.

Welcome To Lilliput

When the voltage you want to measure gets small, though, it can make a big difference. If you're trying to measure 50 millivolts, and you have 20 mV of noise, how valid is your measurement? Not very. In fact, you could get into all kinds of problems by trusting the numbers you get. Luckily, not many situations call for such low-voltage measurements, at least not with a voltmeter. With an oscilloscope, though, it can be a real problem, because you can see small voltages and small signal changes very well, tempting you to try to use the scope in places you would never use a voltmeter. Then, your selection of a close, quiet ground point is much more important.

Carry That Load

Any time you measure something, you have to use a little bit of it up. OK, that's not true of everything there is; you don't need to use any gasoline to float a ball in it and see how high it goes. But, in electrical circuits, you can't get something for nothing. When you measure a voltage, some of its associated current must flow through the measuring instrument. In other words, the voltmeter or scope has a finite resistance which appears to your circuit to be in parallel with the point under test, stealing a small amount of current from it. Is that a problem? Not usually, but sometimes it sure can be. The old analog voltmeters typically had an input impedance of about 20k ohms per volt measured. In other words, if you were measuring 2 volts, the meter appeared to be a 40k-ohm resistor. That sounds pretty high, but is it? On the output of a low-voltage DC power supply, it's meaningless. Heck, at 12 volts, 40k ohms only dissipates 0.3 milliamps, or 3.6 milliwatts of power. That ain't much. But suppose you are measuring the brightness or focus terminal of a CRT circuit with about 1,000 volts on it. Now, your meter appears as 20 megohms (remember, it's 20k ohms per volt). That seems like a lot, but many voltage divider circuits for CRTs are up in the multi-megohm range, thanks to the very high impedance of a picture tube. So, that 20 megohms may pull the voltage down by a significant amount, say 10 or 30 percent. In some circuits it could wipe it out altogether! And, if you happen to be measuring a low-voltage, high-impedance circuit, your voltmeter could swamp that even worse, making it impossible to get any information at all. So, how do you avoid loading down the circuit under test?

Going Up . . .

The only way out is to make the measuring instrument more sensitive, thus raising the apparent input impedance. One of the first instruments to successfully do that was the VTVM, or vacuum tube volt meter. Basically, it was a regular analog meter, but, between the meter movement and your circuit was an amplifier. The amp used a tube, hence the name of the instrument. By boosting the sensitivity, say, 100 times, the amp could have a very big series resistor on its input, making its input impedance a couple of megohms, rather than 20k ohms. That tremendously reduced the loading effect, making the VTVM a highly useful instrument that didn't load circuits down. At one time, the VTVM was a staple in every TV repair shop. I'm sure plenty of people still use them, although, as far as I know, they haven't been made for many years.

The FET, with its tube-like high input impedance, revolutionized measuring instruments. First of all, the VTVM gave way to the FET voltmeter, which was exactly the same thing except for its solid-state amplifying element. But, without the heat, the FET meter didn't drift so much, and the FET didn't age and lose gain over time. It was a big improvement except for one thing: You could apply just about any voltage to the tube's input without damaging anything, but you'd blow a FET very fast if you abused it. So, servicers had to be more careful.

> **"For watching any kind of signals that move, nothing beats an oscilloscope. Period."**

And Now . . .

These days, digital voltmeters have pretty high input impedances. Like FET meters, though, they are easily blown if too much voltage is pumped into them. And some of them aren't cheap! Still, you can't beat a digital meter for measuring unvarying signals. If you want to know the absolute value of a DC voltage, these things will get you closer to the truth than any analog meter. Also, digital meters have autopolarity. That is, if you hook the meter up backwards, all you get is a minus sign next to the value: the numbers will still be correct. On analog meters, you wind up with a meter pin slamming into the left side, and no useful information. Sometimes, you can even ruin the meter movement.

When voltages move, though, the analog meter is still more useful. Although some digital meters have a few segments of a bargraph-type display under the numbers, most don't. And, even the ones that do have them offer a small number of segments, and thus limited resolution. It does beat trying to follow wildly changing numbers, but it doesn't touch what you can learn from the subtle motions of a real meter movement. In the old days (more than 10 years ago), a good tech could infer a great deal from watching a meter movement's subtle dance. I suspect it is rapidly becoming a lost art, which is a shame. If you are skilled with an analog meter, or want to be, get one now while you still can. Or, at least, don't throw your old one out. I must admit, though, that if I could only have one or the other, I'd probably go with the digital meter, simply due to the convenience and much greater precision and accuracy.

I Can See

For watching any kind of signals that move, nothing beats an oscilloscope. Period. If you've spent years with just a meter, your first experience with a scope will be like taking off a blindfold. Suddenly, you can actually *see* signals going by, with all their little bumps and squiggles. It opens a whole new world of understanding of what's going on in a circuit. Most scopes, though, drift a bit and are not anywhere nearly as accurate in absolute terms. So, don't ditch your meter when you start using a scope. You'll find that you use them both together. In fact, some expensive scopes come with metering functions built in. I especially like the ones with cursors on the screen that let you measure voltage, time differences and other signal parameters right off the face of the scope's display. Once limited to exorbitantly priced laboratory scopes, this capability has come down in price to an affordable point. I've seen scopes in the $1,500 range that have it. It's important to recognize, though, that the basic accuracy of the numerical readout may or may not be any better than that of the scope itself, depending upon the design.

Pitfalls

When you measure voltages with a scope, you see them change over time. That's usually good, but it can be a problem, too. Let's say you want to know the voltage of a power supply's output. Your voltmeter says 13 volts, but your scope displays 12.7 to 13.5 volts, because the supply has 800 mV of ripple on it. So, what's the true voltage? There isn't one! At one moment, the voltage may be 12.7 and at the next, it may be 13.5. In order to use this information, you need to know the reason for your measurement. If it's just to get an average voltage, I'd trust the voltmeter and go with 13. If, though, you need to protect a circuit from anything more than 13 volts, it pays to recognize that the supply may instantaneously rise to 13.5 from moment to moment, and do something about it.

Well, there's lots more to measurement technique, but I'm running out of room for this month. Next time, we'll continue this topic. Until then, 73 from KB1UM.

Number 22 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
Staten Island NY 10313-0006

Geography Resources

Most amateur radio operators recognize the relationship between speaking around the world and sharpening one's geography skills. Teachers who use amateur radio in the classroom will attest to the value of learning geography on a need-to-know basis. Adding relevance and a little fun and excitement to the learning process is a winning combination to both gain knowledge and retain it.

A large section of my classroom is devoted to geography reference books and materials, maps, globes, atlases, and letters and stamp albums from unusual or exotic locations. Very often the radio manufacturers give away classroom maps if you request them on school stationery. With the world changing as quickly as it does, it's important that maps and geography resources be constantly updated in the classroom. The reasons for the updating can make for a great discussion and lesson.

Sources

The following list of resources is worth investigating. Some are free, and they will all make good additions to your class library and reference center.

1. World Game Institute: A nonprofit, nonpartisan global research and education organization which utilizes a creative, experiential approach to education. It provides computer software, a World View Map series, World Game Workshops, and publishes statistical data from the United Nations, the World Bank, the World Resources Institute, and other sources. For more information on what is available contact: World Game Institute, 3215 Race Street, Philadelphia, PA 19104; (800) 220-4263.

2. *How to Help Children Become Geographically Literate:* The NCGE (National Council for Geography Education) has published the booklet *How to Help Children Become Geographically Literate*. It helps parents and teachers learn how to teach basic geography concepts to children. Single copies are free, 50 copies cost $7.50, and 100 copies cost $12. For information write: NCGE, 16A Leonard Hall, Indiana University of Pennsylvania, Indiana, PA 15705

3. *WorldWise* Newspaper: *WorldWise* is a monthly thematic world affairs newspaper for grades 8-12. Each issue focuses on one timely topic and features a center spread that puts the topic in clear historical and geographical context. The cost is 75 cents per student per month, or $6.15 per student per year. For more information contact: *WorldWise*, Dept. EF, 4 West Wheelock Street, Hanover, NH 03755.

Photo A. Carole Perry WB2MGP uses globes to make a point with eighth-graders Jordan KB2PYS and Renée KB2QMR.

Photo B. Eighth-grader Rose KB2QMK points out a location on the map to eighth-grader Lisa.

4. ZPG's New Elementary Kit: "The Counting on People: Elementary Population and Environmental Activities" kit is designed for teachers of grades one through six. The kit contains 150 spiral-bound pages of fun elementary population activities and student worksheets which can be easily reproduced. The cost is $19.95 plus $1.50 for shipping and handling from: Zero Population Growth, 1400 16th Street, NW Suite 320, Washington, D.C. 20036.

5. Poster Education: The Global Poster Corporation has produced over 20 posters with the Five Themes of Geography in mind. A detailed ready-to-use set of lesson plans is enclosed with each poster. For a brochure describing the posters contact: Poster Education, 5 Howland Road, P.O. Box 8774, Asheville, North Carolina 28814; (704) 253-4995.

6. Free ERIC *Digest:* The Clearinghouse for Social Studies and Social Science Education is offering free *Digest* copies and a packet of basic information on the ERIC system in general and the ERIC Clearinghouse for Social Studies/Social Science Education specifically. For questions or to request materials contact: Vicki J. Schlene, (800) 266-3815; vschlene @indiana.edu.

7. *Alliance Yellow Pages:* Marycarole Deane, a California TC, has compiled a 12-page directory of publications and materials which have been produced under the auspices of the various Geography Alliances. Included are lesson plan collections, thematic teaching ideas, software, bumper stickers and a T-shirt. A copy of the *Alliance Yellow Pages* can be received for free by contacting: NYGA, Department of Geology & Geography, Hunter College-CUNY, 695 Park Avenue, New York, New York 10021.

8. *Social Studies Standards:* The National Council for the Social Studies has published *Expectations of Excellence: Curriculum Standards for Social Studies.* This document sets down the framework for a K-12 social studies program which can be integrated with the other national standards in geography, economics, civics, and government. Performance expectations are also included. The 180-page book can be purchased for $15 for non-members and $12.75 for NCSS members, plus $2.50 for shipping. To receive a copy write to: Whitehurst & Clark, 100 Newfield Avenue, Raritan Center, Edison, New Jersey 08837; (800)683-0812.

9. Geographic Inquiry into Global Issues (GIGI): Encyclopedia Britanica Educational Corp. has developed a set of secondary instructional materials that give teachers an alternative from standard geography texts through the use of a CD-ROM and three videodiscs. For more information on GIGI, contact: James Dunn, P.O. Box 6115, Boulder, Colorado 80306-6115; (303) 440-7505.

If you use any of these materials in a successful lesson in conjunction with your ham radio classes, please let me know so we can share your experiences with other teachers and instructors. 73

NEVER SAY DIE

Continued from page 4

Arrogant Scientists

Working in the cold fusion field has brought me into contact with both open- and closed-minded scientists. I don't mind if a scientist, or anyone else for that matter, disagrees with others about something. What annoys me is when someone strongly disagrees about something that they haven't bothered to find out about.

"Well," they say, "everyone knows" such and such. Oh, baloney. Sure, we know quite a lot about things we can see and feel. When it gets to the micro and macro we know less. Okay, matter is made of molecules. Molecules are made of atoms. Atoms are made of electrons, protons, neutrons and stuff. Yeah, and what are they made of? Well, quarks. And they're made of subquarks. And then what? We have no idea of how many more layers this goes . . . levels of abstraction. If they're some kind of energy, what kind?

On the macro end cosmologists are theorizing all over the place. The Big Bang comes and goes in popularity as astronomers and astrophysicists come up with new data which requires retheorizing to explain the new data. So they argue over an expanding universe that isn't expanding into anything. They theorize about parallel universes, wormholes and super strings. Then some astronomers screw it all up by discovering that our whole end of the universe seems to be moving off to the left at 435 miles per second, attracted by no one has a clue what, or perhaps repelled. Liberals should like that.

If you've been reading *Newsweek* and *Time*, you know that astronomers and cosmologists are battling each other over a welter of contradicting theories. Cover stories, no less. Every time a group of astronomers comes up with new information, it seems to blow all previous theories into hyperspace. Have you been reading about the Great Wall? The Great Attractor? The missing Dark Matter? Don't wait for the scientists to agree before plunging into this mess because you aren't likely to live that long.

Yes, of course I can recommend a couple of good books. One of the best and most readable is *Exploring the Physics of the Unknown Universe* by Milo Wolff. It's $15 in paperback, so look for it. Milo is a good friend and one of my scientific advisors for *"Cold Fusion."* Also in paperback, at $14, is *The Big Bang Never Happened* by Eric Lerner.

I've a news flash for you: Scientists are no smarter than most of the rest of us. They don't even know much more about most things outside their special niche than we do. The major difference is that they have taken the time to learn a whole lot about one thing. They've become experts on it. Well, you'll be surprised at how little effort it takes to catch up with most of these specialists. When I tackled ham teletype I started from ground zero. Within a year I was writing articles and then I wrote the first book on the subject and had a regular column on it in *CQ*. And I didn't do anything that anyone else with the guts to tackle the subject couldn't have done.

When microcomputers came along I decided it was time to learn about them. When I discovered that there were no decent books or magazines to help me, I started *Byte*. I knew that this incredible new development would spawn a need for information. I was right. When I started it I had to hire an editor who knew about computers. A year later I'd learned enough about computers to edit my next magazine in the field, and to be out lecturing. That wasn't a matter of any great brilliance on my part, just the result of a lot of hard work.

The compact disc got me involved with digital recording, so I had to start fresh in that field. No, I haven't been watching Geraldo, Oprah, Donahue and such. No ball games. No quiz shows. Darned few sitcoms. But I have read a bunch of books and attended conferences. It's your option whether you want to be an expert in something or a dummy. None of this stuff is very difficult to understand if you bother to read. Well, most of it. I have to admit to being over my head on particle physics, where there are over 200 particles flying around. But I'm working at it, so maybe by next year I'll at least be able to ask the experts questions.

Amateur radio is in desperate need of some pioneers. Here we are, stuck in the 1960s with our technology. We should be using digital voice and developing our own data compacting algorithms. We should be zapping data through our ham satellites at 28.8 kB, at the least. Instead we are still fighting in pileups when someone comes on from a rare country. Or not rare, if band conditions are lousy. Heck, I've seen pileups just for Venezuela when DXers get really desperate.

With the Internet looming as an alternative to amateur radio, we'd better get cracking. We have the satellite bands. We even have some satellites. What we don't have is the technology. We got started with packet around 20 years ago, and have been progressing at a snail's pace ever since. We pioneered sideband 40 years ago and haven't budged an inch since. We got busy with repeaters 25 years ago and we've hardly seen a smidgen of progress since. In 1970 I had a repeater on a local mountain which repeated on either 10m or 6m as well as 2m. How many do we have like that 25 years later? I'ze regusted.

Neither my mail nor my reading of a stack of ham club newsletters every month give me any cause for hope. How's about getting off your duff? I want to start seeing some articles showing progress. And no, you're not too old to start something new. I'm 73 and busy learning. Doc Patterson, the chap who got the first cold fusion patent, is my age. When a nine-year-old girl can get an Extra Class ticket and a 73-year-old invent circles around some of the world's top laboratories, what's your excuse?

If you can't provide some articles for me to publish to help jolt us into action, at least review some books we can read that may help us get started.

It's Impossible

When John Campbell W2ZGU, the editor of *Analog*, told me about the Heironymous Machine I frankly didn't believe him. It was just too preposterous. It violated everything I'd been taught. It violated my experience. It was obviously completely impossible. Then came Henry Gross' Wishing Machine, which was even more absurd. John was an amazing genius and he was into everything. A lunch with him was like riding an intellectual roller coaster, going into electrochemistry for a few minutes, then into nuclear physics, psychology, sociology, and so on. But when he came up with stuff that was patently absurd, even though the machines had been patented, I rolled my eyes.

I had the same reaction when pyramids came along. Little paper pyramids can sharpen razor blades? Sure. And mummify dead animals? Har-de-har. But what if little paper pyramids really can sharpen razor blades and there are photomicrographs to prove it? What do you do when something is clearly impossible, yet it happens?

Well, G. Harry Stine has fiendishly come up with seven machines you can build for yourself and test. They're all simple to make, and the really irritating part is that every blessed one of them works. None of them should or even could possibly work. The nice part of it is that they all will work, whether you believe they will or not. Even worse, they'll work with the double-blind scientific test too. You're going to have to face the fact that they all do work and that we haven't a scientific clue as to why.

The scientific approach to all this is to pooh-pooh it and not bother to test any of them since there's no known way they can possibly work. That's the approach some old-line scientists have used with cold fusion, and never mind the dozens of labs around the world generating completely unexplainable large quantities of heat. It isn't possible, therefore there's no reason to check it out.

Now, if you'd like to upset yourself and prove the completely impossible is real, invest in Stine's book. It's 207 pages in paperback and is available from Top of the Mountain Publishing, Box 2244, Pinellas Park FL 34664. Send $18 (postpaid) for Stine's *Amazing and Wonderful Mind Machines You Can Build.*

The book shows the tube version of the Heironymous Machine, as well as a transistorized version, and even a new IC model that you can assemble in a few minutes. This gadget will tell you what metals are in anything you put by the input coil, and what percentages of each metal. This, of course is completely impossible. But it gets worse. You detect the presence of metals by feeling a plastic or glass plate which is over the output coil. Yes, this fool thing will work whether you believe it or not. It'll work for most people, but not all. Around 80%. And for those for whom it works, it works repeatably, even when the operator has no clue as to what is being tested.

It gets worse. The damned thing keeps right on working with the power turned off. Working repeatably. Now explain *that* to someone. But, alas, it gets even worse. It turns out you can replace that IC circuit with an inked drawing of the circuit, connected to the input and output coils with thread instead of wire, and it keeps right on working, like the Energizer Bunny. You do have to re-ink the battery drawing now and then to keep it running. Apparently the battery drawing runs out of juice when the ink begins to fade.

All this is pure hoakum, right? It's so foolish you'd never try to build even the simple machines that Stine describes in detail. It's not worth reading about. Okay, fine, don't look through Galileo's telescope. Don't hang a couple nickels in a potassium carbonate solution and see if excess heat is generated. Laugh and jeer at gullible old Wayne. Obviously I'm losing what's left of my marbles. Well, that's what a bunch of readers were saying when I started pushing 2m FM and repeaters back in the 1960s. They said it again when I pushed microcomputers in 1975. I sure must have started out with one big bag of marbles to lose so many and still keep going. So make poor old Wayne look dumb. Get the book, build the gadgets Stine describes, and prove they positively won't work by testing them yourself and on a bunch of friends.

My grandfather showed me how to dowse with a beech tree branch when I was about seven years old. It worked for both of us. Dowsing works just fine for people all around the world. They dowse for water, oil, minerals, underground pipes, and so on. Nobody has a clue as to how or why dowsing works, so the pathological skeptics just refuse to accept it. To me, when something unexplainable happens, that's the time to start finding out why, not the time to say it's all a fake, never happened, and ignore it. We've lost a lot of valuable knowledge and experience via pathological skeptic pressure.

Just look at what the head of the DOE has been able to do to the American cold fusion research effort. He almost single-handedly has put America way behind many other countries in this new field; Japan in particular. The cold fusion pioneers in India and Italy are heros, here they were ridiculed and humiliated. Well, that's what happens when our government gets involved with just about anything. The government seems able to screw up everything it does.

Virtually every major contributor to health care cost escalation has been caused by government meddling. Ditto our school system, which is the worst in the developed world, and making us less and less competitive with the far

better educated people in other countries. When Bulgarian school kids easily outperform ours it's almost time to do something about getting the government out of the education business. I keep harping on that, don't I? Well, you aren't *doing* anything.

Now send for that book and stop procrastinating. And renew your subscription to *73* while you're at it. Heck, subscribe to *Radio Fun* too, it's only $35 for the combo (every radio and TV program ends with a commercial, right?).

Committing Slow Suicide

Every now and then a reader sends me a newspaper or magazine article claiming that the evidence that magnetic fields can make people sick is exaggerated. Just as the tobacco companies spent big money to buy scientists to claim that they hadn't yet seen any conclusive evidence connecting smoking and cancer, the power companies are buying as many scientists as they can to keep from being forced to re-route power lines away from schools and to move distribution transformers away from houses.

If you've been reading my stuff for long you know that I'm not a Chicken Little. I do my homework carefully before I go out on a limb and report what I've found to you. You've never seen me getting all het up over acid rain, the nuclear winter, the greenhouse effect, Alar, and all those other similar "scientific" ecoscares.

For those who have been brainwashed by the media and aren't sure that old Wayne is on firm ground, I've cited several excellent books on the subject. Well, there's another one just out. Stop being chintzy and spend the 10 bucks. Look for *The EMF Book* by Mark Pinsky; Warner Books 67004-9.

For several years I've had a list of the scientific papers reporting on research in the field posted on the *73* BBS. Hundreds of papers. On several occasions this bibliography has come in handy for groups fighting power companies who have wanted to string high tension wires near their homes or schools, helping them win. When the BBS activity fell off, with most readers turning to the Internet for entertainment, I closed down the BBS. If there's enough interest we might post the list on the Internet. It runs to around 80 pages, so it's not trivial.

The Meaning For Hams

If you are in an area where you are in much more than 1 miligauss of magnetic field you are adding to your risks for any number of illnesses. These fields have much more of an effect on rapidly growing things, like kids and babies during pregnancy. And remember, the changes in the DNA which these microcurrents cause are not going to be in any way beneficial. When you damage DNA you are causing long-term Forrest Gump-type problems. Ditto when you screw with your immune system.

Your body is generating all kinds of stuff that can cause trouble when your immune system slacks off. Millions of tiny cancers, and so on, are handled by your immune system. Unless it gets damaged, in which case all kinds of awful things can result. Micromagnetic fields interfere with the communication between your cells, interfering with their normal function. This probably explains why hams have such an elevated cancer risk compared to the average couch potato.

You should get a miligaussmeter and check out the fields in your shack. Your transceiver may not be all that bad, but if you're running a linear, you're probably going to find that you have to move it several feet from where you've been using it to get the field down to a safe level.

The worst problems aren't from steady fields, but from rapidly changing fields. This is suspected to be the reason there are so many illnesses reported near power company substations, where huge transients are generated regularly. If you are a CW operator and are running a linear within a few feet of your body, this could explain why you have gradually turned into a mental basket case and have been writing really stupid letters to me.

Sure, I joke about the surprising number of Extra Class hams who are certifiable nut cases, but there's a lot of data suggesting that I may not be exaggerating as much as I pretend. The Extra Class hams I know who are the sanest are those who cheated to get their tickets and who never operate CW. Hmmm, perhaps a good ham lawyer could bring a class action suit against the FCC for forcing hams to drive themselves crazy with the code?

But, in addition to screwing up the brain, if CW is also causing cancers, why take unnecessary chances? Move the linear. I have no problem with hams enjoying CW. It's fun. But that's no reason to slowly accelerate the receipt of your Silent Key certificate. We all have enough problems keeping our immune systems in good shape as it is. It gets weakened when you get too tired, or if you have a serious trauma. This explains why spouses often die shortly after their husband or wife dies. The traumatic shock lowers the immune system so that any passing germ or virus can grab hold and do them in. For instance, about 33 hours after a fight with your wife you can expect a cold or some kind of seeming accident.

We're very fortunate that one of the world's leading researchers in the EMF field is Dr. Ross Adey K6UI. I've published his testimony before Congress in *73*. He testified on the dangers of cellular telephones, police radar units, and magnetic fields around the home.

If you or your family are still using electric blankets, you're asking for major problems. Most of the other home electronic equipment is fairly benign, or is used for only a short time. But if you've seen some of the photos of guys who lost their chins to cancer due to using electric shavers, you'd better understand what a few added miligauss applied regularly can do.

The most vulnerable are youngsters, but extended exposure can do in even the nastiest of old-timers.

Making Money From EMFs

You can get some darned good gaussmeters now for well under $100. An enterprising ham or ham club could make a good buck and do a fabulous public service by gaussing out homes and businesses for people. And every member's ham shack. Buy a meter and then charge $20 or so to check customers for dangerous magnetic fields. How bad is it around their microwave? Around their computer? Their projection TV?

With classified ads in the local papers, want advertisers, and shoppers, a club could be kept busy gaussing out the town. At the least it could be a nice spare-time business for someone. Print up a nice-looking certificate you can issue showing the home or business to be free of dangerous magnetic fields.

As you find and eliminate magnetic fields you can send releases on your work to the media and thus get more publicity for your work, and for the ham club. It'll be nice to be seen as something other than a bunch of technonerds with those ugly big radio towers who cause interference to TV and hi-fi systems. And who knows, the publicity could get some kids to eschew TV and come to a club meeting so your old-timers can make them wish they'd never come.

Memory Loss

A reader bought a brand-new rig, one with a bunch of memories. But he found that when he turned off the rig the memories evaporated. That didn't seem right to him, so he went back to the store where he bought it and asked. This was a branch of a national ham chain, mind you. The salesman said oh yes, that's the way these rigs work. He then demonstrated this with the one on display. Sure enough, the memories all blew away when the power switch was turned off.

Now, being one of the small percentage of hams who had managed to graduate from college with some reading comprehension, our hero did the unbelievable—he consulted the instruction book. Yep, the memories were supposed to survive minor emergencies such as turning off the big switch. The power source for the memories was a small lithium battery buried deep inside the monster. Very deep.

Our hero, only semi-daunted by this news, got out his tools and started the excavation. What he eventually found at the bottom of the pit was a dead lithium battery. Would you believe that the manufacturer had soldered the thing in? After a short memorial service, more filled with oaths than eulogies, our hero carefully soldered in a new lithium battery, making sure not to fry the battery in the process—which may be what happened to the factory-installed battery—and refilled the excavation. Yes, of course the rig worked just fine, complete with more permanently memorized frequency settings.

So, I suggest, if you buy a rig with Alzheimer's, take it back to the store and don't fall for any baloney. Let them disinter and resurrect the deceased battery.

Of course, if this whole memory business is more than you can deal with, then never mind.

Fighting Senility

This is a subject which should be near and dear to at least 70% of the active hams. In case you don't read the *Wall Street Journal*, you missed an interesting article on warding off senility. Luckily reader N8PWY is a much better person than you and keeps his Uncle Wayne's need for interesting clippings in mind. Wayne does not read any newspapers. No time. So it's up to you to check through your papers and clip out and send me anything having to do with UFOs, ham radio, medical facts, scuba diving, and so on. I haven't made any secret of what interests me, so keep some scissors handy.

Anyway, it turns out that not only should you be out there walking briskly for a couple of miles a day, getting some actual sun rays into your eyeballs, taking your vitamins, and stuff like that, your brain also works on the use-it-or-lose-it basis. Once you start vegetating, your brain is going to turn into a turnip. So stop beefing about my editorials not all being about amateur radio. Start getting some of the books I recommend. Get some others too. And if you find any that are real interesting, let me know so I can buy them too. I may suffer from a lot of old-age miseries, but turning senile isn't likely to be one of them. I read every minute I can spare. I jog a couple miles every day. I take my vitamins. I eat healthily. The result is that, despite some recent massive emotional traumas caused by crooked employees, I'm going strong.

This is one of the reasons that people who retire and take it easy die so fast. Getting out there for golf may give you exercise, but it isn't going to keep your brain from turning into pudding. It isn't too late to get some books and start learning. Or maybe taking on some kids for elmering. Or even some doddering old-timers who could use the company ham radio offers. You sure don't get lonely when you have a ham rig at hand, and loneliness is one of the major senior complaints.

SPECIAL EVENTS

Number 23 on your Feedback card

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

JUNE 3

KNOXVILLE, TN The Radio Amateur Club of Knoxville will hold its 29th annual Hamfest/Computer Fair at the Jacobs Bldg. in Chillowee Park, from 8 AM-3 PM. Setup Fri. eve, and before the doors open on Sat. VE Exams. Talk-in on 147.30 and 224.50. Call *Angela Crigger N4RPR, (615) 694-9071.*

JUNE 4

BUTLER, PA The 41st Breezeshooters' Hamfest will be held 8 AM-4 PM on the Butler Farm Show grounds. Talk-in on 147.96/.36. To reserve Flea Market tables, send check for $15 per table and an SASE to *Rey Whanger W3BIS, 5530 Cove Run Rd., Cheswick PA 15024-9451.* For General info call the *Breezeshooters' Hotline at (412) 828-3694.*

MANCHESTER, MI The 18th annual Chelsea Swap 'N Shop will be held by the Chelsea ARC, Inc. at the Chelsea Fairgrounds, starting at 8 AM. Flea Market Setup at 6 AM. Talk-in on 146.980 Chelsea Rptr. For info, mail your request with an SASE to *Chelsea ARC, Inc., P.O. Box 325, Manchester MI 48158;* or call *Gary R. Widmayer, (313) 428-9398.*

MANASSAS, VA The Ole Virginia Hams ARC will sponsor the Manassas Hamfest/Computer Show at the Prince William County Fairgrounds, starting at 8 AM. Tailgaters 7 AM. Talk-in on 146.37/.97 and 223.06/224.66. Commercial vendors call *Joe K4FPT at (703) 257-9719.* For general info, call *Mary Lou KB4EFP at (703) 369-2877.*

JUNE 10

WINSTON-SALEM, NC The Winston-Salem Hamfest/Computer Fair will be held at Dixie Classic Fairgrounds, 8 AM-3 PM, by the Forsyth ARC, Inc. VE Exams by pre-reg. only. Talk-in on 146.04/.64. Send SASE to *Bill Patterson KD4RGB, Winston-Salem Hamfest, P.O. Box 11361, Winston-Salem NC 27116. Tel. (910) 723-7388 (24 hrs.).*

JUNE 11

COVINGTON, KY The Northern Kentucky ARC will hold "Ham-O-Rama '95"at the Erlanger KY Lions' Park (on Sunset Ave.) starting at 8 AM. Flea Market set-up at 6 AM. Talk-in on 147.255+ or 147.375+ Rptrs. Contact *KC4FET, c/o NKARC, P.O. Box 1062, Covington KY 41012. Tel. (606) 341-1213; FAX (606) 384-4002.*

HANOVER, PA The Pleasant Hill Computer/Hamfest will be hosted at Pleasant Hill Fire Co., (RTE 94, 5 mi. So of Hanover) by the Hanover Area Hamming Assn.. Time: 8 AM-???. Talk-in on 146.895-. Contact *Rodger Gibson N3ICJ, P.O. Box 820, Hanover PA 17331; Tel. (410) 239-8451.* To inquire about VE Exams, call *Bill NZ3J, (717) 359-7090.* Testing will be at 8 AM.

QUEENS, NY The Hall of Science ARC Hamfest will be held at the NY Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. Setup at 7:30 AM. Buyers admitted at 9 AM. Talk-in on 444.200 WB2ZZO Rptr., 146.52 simplex. For info, call evenings only, *Charles Becker WA2JUJ, (516) 694-3955* or *Arnie Schiffman WB2YXB, (718) 343-0172.*

WILLOW SPRINGS, IL The Six Meter Club of Chicago, Inc., will hold their 38th annual Hamfest at Santa Fe Park, 91st and Wolf Rd., starting at 6 AM. For advance tickets, contact *Mike Corbett K9ENZ, 606 South Fenton Ave., Romeoville IL 60441.* Dealers, for Pavilion reservations contact *Joseph Gutwein WA9RIJ, 7109 Blackburn Ave., Downers Grove IL 60516; Tel. (708) 963-4922.* Talk-in K9ONA 146.52, or K9ONA/R 146.37/.97 (107.2 Hz).

WINFIELD, PA The Central Pennsylvania Ham and Computerfest will be sponsored by the Milton ARC at the Union Township Fire Co. Carnival Grounds. The event starts at 8 AM. Talk-in on 146.37/.97, 147.78/.18, 146.52. For info, call *Dave Welker AA3BO, days at (717) 286-0787; eves., (717) 286-0787,* or write *S.V.A.R.C., P.O. Box 73, Hummels Wharf PA 17831-0073.*

JUNE 15-18

RED DEER, ALBERTA, CANADA The Central Alberta Radio League will host their 25th Anniversary Picnic and Hamfest at the Burbank Campsite, located approx. 8 km. NE of Red Deer, Alberta. Talk-in on 147.150+ MHz, or 146.520 simplex. Contact *Bob VE6BLD, Box 1091, Lancombe Alberta TOC 1S0, Canada. Tel. (403) 782-3438. Packet VE6BLD @ VE6RDR.AB.CAN.*

JUNE 16-17

ST. PAUL, MN "Electronics Fair '95" will be held at the Aldrich Arena, 1850 White Bear Ave., Maplewood MN. This is an Amateur Radio, Hobby Electronics, and Computer Swap & Show. Times: Fri., Flea Market 6 PM-9:30 PM; Exhibits 6 PM-10 PM. Sat., Flea Market, 6 AM-3:30 PM; Exhibits, 8 AM-3:30 PM. Electricity not available in flea market. For commercial booth and club exhibit info, contact *Electronics Fair, P.O. Box 26331, St. Paul MN 55126. Tel. (612)*

653-9999. Computer users, call *HAMLINK, (612) 426-0000 (300-28,800 baud)* and *(612) 426-1010 (300—14,400).*

JUNE 17

BANGOR, ME The Pine State ARC will hold the "Bangor Hamfest" 0800–1300 hrs at Herman Elementary School. Talk-in on 146.34/.94 and 146.52 simplex. There are 3 campgrounds and many motels within 5 miles of the Hamfest. Contact *Roger W. Dole, RR #2 Box 730, Bangor ME 04401; Tel. (207) 848-3846.*

DUNELLEN, NJ Raritan Valley RC "95 Hamfest" will be held at Columbia Park, 7 AM-2 PM. Talk-in on 146.625 rptr, 146.520 simplex. Contact *John Manna WA2F, (908) 722-9045,* or *Bob Pearson WB2CVL, (908) 846-2056 before 8 PM.*

LANCASTER, PA A Computer, Electronics Show, and Hamfest will be held at Centerville Jr. H.S., 865 Centerville Rd, 9 AM-2 PM, by the Red Rose Repeater Assn. Talk-in on 147.015(+) and 449.575(–). Vendors, contact *Mark Walton, (717) 560-2321; FAX (717) 560-2920.*

MIDLAND, MI The Midland ARC will hold their 20th annual Hamfest at the Midland Nat'l. Guard Armory 8 AM-1 PM. VE Exams. New and used amateur electronics and equipment. Talk-in on 147.00(+) Midland. Contact *MARC Hamfest, P.O. Box 1049, Midland MI 48641.* Please SASE, or call *(517) 832-3053 eves. and wknds.*

JUNE 18

CAMBRIDGE, MA A Flea Market will be held 9 AM-2 PM at Albany and Main Sts., by the MIT Radio Soc. and the Harvard Wireless Club. For reservations/info, call *(617) 253-3776.* Mail advance reservations before June 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725 pi 2A W1XM/R.

MUNSTER, IN The Lake County ARC will hold their 23rd Annual Dad's Day Hamfest at the Lake County Fairgrounds in Crown Point IN. Setup at 6 AM, open to the public at 8 AM. VE Exams at 9 AM. Talk-in on 147.000(+). Contact *John Gianotti KF9GW, 1513 Camellia Dr., Munster IN 46321. Tel. (219) 922-1065.*

JUNE 18-25

CERRITOS, CA Yaesu U.S.A. will sponsor "DX-Caribe Cruise '95", the second in a series of Amateur Radio theme cruises. Grid Square Itinerary: FK-42 Aruba, June 16, 17, 18; FK-53, 63, 74, 84, 85, 95 Dominca, June 19/June 20; FK-95, 94, 93 Barbados, June 21; GK-03, FK-93 Martinique, June 22. For cruise info, contact *Landry & Kling, Inc., 1390 South Dixie Highway, Suite 1207, Coral Gables FL 33146. Tel. (800) 448-9002.* Inquiries from outside the US may be directed via FAX to *Landry & Kling, (305) 661-0977.* Operations will be mobile from Dolphin Cruise Line's S.S. Ocean Breeze, and DX-pedition style from beach locations.

JULY 4

HARRISBURG, PA The Harrisburg RAC will hold a Hamfest at Bressler Picnic Grounds 8 AM-1 PM. Setup and tailgating at 6 AM. NO overnight camping. All vendors must collect PA sales tax. Talk-in on 146.76/.52. For table reservations, contact *Tom Hale WU3X, Box 418, Halifax PA 17032;* or call *(717) 232-6087* for info.

JULY 27-30

COLORADO SPRINGS, CO The Central States VHF Soc. will hold its annual conference July 27-30. Papers for inclusion in the conference proceedings, or for presentation at the conference are hereby solicited. Deadline for papers is early May, 1995. For info, please contact *Hal Bergeson W0MXY, Program Chairman, 809 East Vermijo Ave., Colorado Springs CO 80903. Tel. (719) 471-0238.*

SPECIAL EVENT STATIONS

JUNE 2-3

BATTLE CREEK, MI Southern Michigan ARS will operate W8DF June 2nd 2100Z-June 3rd 2100Z, to commemorate "Urbandale Area Homecoming." W8DF will operate CW and SSB in the lower 25 kHz of the General 10-80 meter bands, and the Novice subbands. For a Special Event Card, send QSL to *W8DF, P.O. Box 934, Battle Creek MI 49016.*

JUNE 2-4

DES ARC, AR The North Central Arkansas ARS will sponsor Station KB5DBI June 2 1800Z-June 3 0200Z, and June 3 1600Z-June 4 0200Z, to commemorate Steam Boat Days. Operation will be in the General portions of 15, 20 or 40 meters, and the Novice portion of 10 meters, if conditions permit. For a QSL, send a 9" x 12" SASE (or send $1.00 and we will provide the envelope and postage) to *NCAARS, P.O. Box 911, Judsonia AR 72081,* or to *KB5DBI at the call book address.*

HAINES FALLS, NY The Long Island Mobile ARC's Junior Operators Committee will operate N2LSK from their QRP camping weekend at North Lake Camp Grounds in Greene County. Operation will be on or near 7.040, 3.560 CW and 7.225 phone. For QSL, send SASE to *Robert Todaro N2JIX, 2218 E. 73rd St., Brooklyn NY 11234.*

NORTH OLMSTED, OH The West Park Radiops ARC will operate W8VM on Satellite and HF June 3 0000Z-June 4 1600Z, in conjunction with All Scout Weekend. Operation will take place on satellites RS-10/11, RS-12, and RS-15, as the orbits and modes permit. When satellites are not available, W8VM may be found on 3.880, 7.280, and 14.280 MHz. CW operation will be 30 kHz up into the General portion of the CW bands, and in the Novice CW bands. QSL with regular SASE for a card, or 9" x 12" envelope for a special certifi-

cate. Mail to *W8VM, 513 Kenilworth Rd., Bay Village OH 44140.*

TORONTO, CANADA The Boy Scouts of Canada, Greater Toronto Region, will operate VE3TXU from Humber West Area Competition Camp. Operation will be Sat. June 3rd, 1300 UTC-1600 UTC, 1700 UTC-2000 UTC, and 2200 UTC-0000 UTC. Frequencies: 3.840, 3.940, 7.090, 14.135, 14.290, 21.360, 28.990. For a certificate, send a 9" x 12" SASE with QSL to *VE3TXU Jim Bois, 55 Alexander St., Tottenham Ontario, Canada L0G 1W0.*

JUNE 4

PLYMOUTH, CT Radio amateurs in Plymouth will operate designated stations to celebrate the bicentennial of the Town of Plymouth. A limited number of special certificates are being made available by the Bicentennial Committee to commemorate the contact. Operation will be in the General portions of 160, 80, 40, 20, 15, and 10 meters as propagation allows. QSL with an SASE to *K1EM, P.O. Box 12, Pequabuck CT 06781 USA.* Include a shipping container large enough to hold the 9 1/4" x 13 3/4" certificate, or a No. 10 business envelope for a folded certificate; along with sufficient return postage.

JUNE 10

BROOKLYN, NY The Kings County ARC will operate WA2ZWP 1400Z-2300Z to commemorate the 170th Birthday of Fort Hamilton Army Base. Freq.: 3.943, 7.243, 14.343, 21.343, 28.343. For a certificate, send QSL and a 9" x 12" SASE to *Lenny Marinello KB2HQE, 2512 West 1st St., Brooklyn NY 11223.*

MT. CARMEL, IL The Radio Amateur Downstate IL Organization will operate Club Station WD9GTW 1700 UTC-2300 UTC, at the Old Time Radio Days 100th Anniversary of Meisner Radios. You will find them on the General phone subbands on 15, 20, and 40; 28490 on 10m and 146.940 Mt. Carmel Rptr. For a certificate, send SASE with QSL to *R.A.D.I.O., 827 Broadmoor, Mt. Carmel IL 62863.* For info, call *(618) 262-7111.*

MT. PLEASANT, IA The MT. Pleasant IA ARC will operate W0MME 1500Z-2200Z at the Heritage Boy Scout Camporee. Operation will be in the lower 50 kHz General class portion of the 80, 40, 20 meter phone bands. For a QSL, send SASE to *Dave Schneider WD0ENR, 1675 Old Hwy. 34, Mt. Pleasant IA 52641.* The Camporee will be sponsored by the Midwest Old Threshers and the Southeast Iowa Council of Boy Scouts.

JUNE 10-11

PIERRE, SD The Pierre ARC will operate AA0TS 1400Z June 10-0200Z June 11 from the State Capitol City, at the 66th annual South Dakota State Fire School. Phone operation will be at 3.940, 7.240, 14.240, 28.340, 145.350/.750. CW will be at 7.125. For a certificate, send QSL and a 9" x 12" SASE to *Pierre ARC, P.O. Box 1261, Pierre SD 57501.*

JUNE 11

FRANKLIN, NJ The Somerset County ARS will honor Guglielmo Marconi by holding a Special Event Day at Marconi Plaza in the Somerset section of Franklin Township. Station NW2P will be on the air 1300 UTC-2100 UTC (8 AM-4 PM local). Additional stations will operate at other Marconi sites: Cape Cod, Newfoundland, and England. Voice and CW: 15m Novice, 17m and 20m General, 2m and 6m SSB, 448.175(-) and 146.58 simplex. For a commemorative certificate, send your QSL card and a 9" x 12" SASE to *SCARS, P.O. Box 742, Manville NJ 08835.*

JUNE 17

LAPEER, MI The Lapeer County ARC will operate KG8CL 1200Z-0000Z, to commemorate the end of WWII. The Yankee Air Force and Dupont Airport are sponsoring this event. Operation will be on the lower portions of the General phone bands. Vintage gear of the era will be used on 40 meters. QSL via *LCARA, P.O. Box 46, Hadley MI 48440.* Please enclose an SASE.

JUNE 17-18

OAK PARK, MI The Oak Park ARC will celebrate the 50th Anniversary of the incorporation of the City of Oak Park MI by operating W8MB 1600Z-2400Z June 17th and 18th. SSB freq.: 7.280, 14.280, 21.380 and 28.480 MHz. For a certificate, send QSL card with SASE to *Oak Park ARC, 14300 Oak Park Blvd., Oak Park MI 48237.*

WESTON, WV The Central ARA, in conjunction with the Stonewall Jackson Lake Sport and Water Show, will operate KC8BK 1300Z-2000Z June 17th and 18th, to commemorate the 132nd Anniversary of West Virginia becoming the 35th State. Operations will be in the lower portion of the General 80 to 15 meter phone bands, and the 10 meter Novice phone subband. For a certificate, send a 9" x 12" SASE and QSL to *C.A.R.A.—KC8BK, P.O. Box 1487, Weston WV 26452.*

JUNE 28

KENO, OR The Keno ARC will operate WD6EAW 1600Z-0200Z as part of the ceremonies rededicating the Crater Lake Nat'l Park Lodge. This will commemorate the 80th Anniversary of the opening of the lodge. Crater Lake is the deepest lake in the U.S. Operation will be in the lower portion of the General 80, 40, 20, 15 and 10 meter subbands. For QSL, send an SASE to *Keno ARC, P.O. Box 653, Keno OR 97627.*

JUNE 30-JULY 4

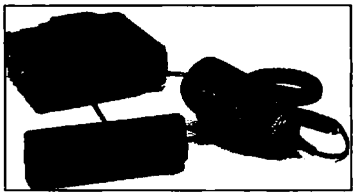
OSHKOSH, WI Members of the Winnebago ARC will operate AA9GO 1600Z-0300Z June 30–July 4, to celebrate the 24th annual Sawdust Days Festival. Operation will be on the 80 to 10 meter bands. Send QSL and SASE #10 envelope to *AA9GO, Michael O. O'Connor, 519 Franklin St., Oshkosh WI 54901.*

Number 24 on your Feedback card

NEW PRODUCTS

Compiled by Mike Nugent WB8GLQ

YAESU

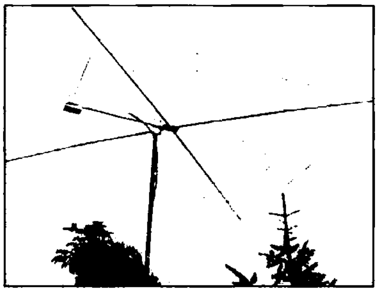


The FT-8500 from Yaesu is a deluxe compact FM mobile transceiver for both 2 meter and 70 cm operation. It includes two new features unique to this mobile: the FS-10 Smart Controller Microphone, and Spectra-Analyzer. For the first time ever, all radio functions are housed in the microphone. The FS-10 all-in-one Smart Controller Microphone permits total transceiver control from the palm of your hand. With its unique joystick-type lever, tuning and menu programming are now quick and straightforward.

Spectra-Analyzer allows you to view channel occupancy above and below your current operating frequency. A simple turn of the dial centers a signal of interest on the scope. Spectra-Analyzer also allows you to watch activity within your memory banks.

The FT-8500 is the first Yaesu mobile with a rear-panel data jack for packet. It has six-pin connections for data input, PTT, 9600 bps and 1200 bps receive data, squelch status, and ground.

For more Information, contact *Yaesu USA, 17210 Edwards Road, Cerritos, CA 90703; (310) 404-2700.* Or circle Reader Service No. 206.



WB2GMK ANTENNAS

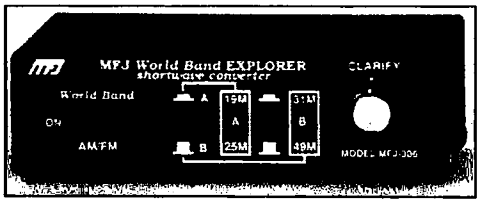
WB2GMK Antennas has announced the "CobWebb," a highly-efficient, limited space HF antenna designed by Steve Webb G3TPW, and manufactured by SRW Communications in Yorkshire, England. This antenna covers 14, 18, 21, 24 and 28 MHz with a square design only 8 feet on each side. It weighs only 14 lbs. (6 kg), so it mounts easily on a lightweight TV-type pole. Despite this ultra-compact design, the manufacturer's specifications indicate that the antenna functions at the same efficiency as a full-size, half-wave dipole on each band.

The CobWebb's horizontal polarization greatly minimizes RFI problems when compared to a vertical or vertically-polarized loop. Plus, it is extremely wide-banded on all bands, yet still exhibits a remarkable efficiency due to its exact match to 50-ohm coax. Its pure omnidirectional pattern, with virtually no nulls, makes it an excellent choice for DXing from small sections of real estate where larger arrays are impractical or not permitted.

The antenna will easily handle a full gallon and is rated to withstand 100 mph winds. It is extremely easy to assemble and install due to the use of Fiberglas spreaders and supports, as well as a preassembled feedbox and resonators.

The CobWebb is priced at $318 plus shipping. For more information, contact *WB2GMK Antennas, 2219 High Point Drive, Brandon, FL 33511; phone or fax (813) 653-3131.* Or circle Reader Service No. 201.

MFJ



MFJ Enterprises, Inc. has announced the MFJ-306 World Band Explorer Mobile Shortwave Converter, which allows you to visit the world while you drive. The MFJ-306 will convert your AM car radio into a world band shortwave receiver at the push of a button. Unlike local FM and AM radio stations that fade out after a few miles, the MFJ World Band Explorer will let you enjoy worldwide shortwave stations throughout an entire trip, day or night, providing programming that cannot be found on AM or FM radio, or even on cassette tapes. It will monitor the entire 19, 25, 31 and 49 meter international shortwave broadcast bands.

The World Band Explorer is very easy to install and use. It works on all car radios, even the newer digitally functional dials. It measures just 5 x 1-1/2 x 3-1/2 inches, and has a push-button to select world band reception or your AM/FM radio. And, it comes with MFJ's famous "No Matter What" one-year unconditional guarantee.

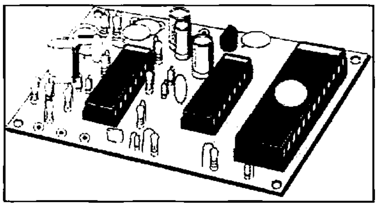
The MFJ-306 is priced at $79.95. For more information or to order, contact any MFJ dealer or *MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762; or call (601) 323-5869, fax (601) 323-6551, or order toll-free at (800) 647-1800.* Or circle Reader Service No. 203.

LOGSAT SOFTWARE CORPORATION

LogSat Software Corporation has formed a joint international business venture to develop, produce and distribute a commercial satellite tracking program called "LogSat Professional version 5.0 for Windows."

LogSat Professional allows both experienced and inexperienced computer owners to track thousands of satellites in dozens of Windows with all types of visual graphics. The program can be used by everyone from home-based owners with satellite dishes who want to watch overseas programs, to ham radio operators and professional ship/aircraft captains who rely on GPS tracking fixes.

For the price and more information, contact *LogSat Software Corporation, 425 S. Chickasaw Tr., Suite 103, Orlando, FL 32825; (800) 350-3871.* Or circle Reader Service No. 202.



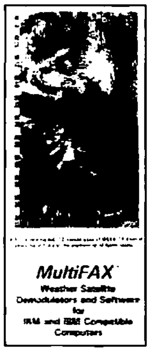
Hamtronics

Hamtronics' new CWID-2 Module provides, in response to customer requests, just the CWID portion of the original CMOS COR-4 Module. The CWID-2 Module features small size, ease of assembly and maintenance, versatility, and a thorough manual that describes how to take advantage of all the available options. It uses all CMOS logic, operates on 7-15 V at only 3 mA, and is easy to fit into existing enclosures because of its small size (only 1-3/4 x 3-1/8 inches). The factory programmed EPROM saves assembly time and allows longer messages than the earlier diode-matrix type CWID module—enough room for up to 200 characters. The CWID-2 can also be set to repeat a message continuously for beacon operation.

The unit has adjustable output level, tone, speed, and interval timer. Installation is easy; the thorough manual describes how to adapt the CWID-2 for various applications.

For the price and more information, contact *Hamtronics, Inc., 65-F Moul Rd., Hilton, NY 14468-9535; (716) 392-9430, fax (716) 392-9420.* Or circle Reader Service No. 204.

MULTIFAX



MultiFAX has announced Version 7 of the MFMAP software used with the MultiFAX WEFAX Image Capture System. This software is used to control the MultiFAX demodulator, as well as to capture and process (enhance, zoom, grid, colorize, etc.) the resulting satellite images. This new version, MFMAP7, sets the standard for power, speed and ease of use.

While retaining all of the functions of earlier versions, MFMAP7 contains the following new features: built-in satellite tracking, real-time on-screen output of the elevation and azimuth of the polar orbiting satellites, automatic computer controlled tracking capability (for use with the Kansas City Tracker), Record Level Meter with a graphical display of signal level, a new record option for NOAA satellites using the onboard crystal clock, easier image enhancement (using the new Palette Function), and MFREC and TIMER software to make unattended recording a snap.

MFMAP7 is priced at $49 plus S&H for MFMAP6 users; it is supplied with all new MultiFAX demodulator purchases after April 5, 1995. For more information, contact *MultiFAX, Route 1, Box 27, Peachland, NC 28133; (704) 272-9028, fax (704) 272-9036. BBS (716) 425-8759.* Or circle Reader Service No. 205.

XURON CORPORATION

XURON Corporation is offering a new catalog that includes a full line of specialty hand shears, flush cutters, wire cutters, pliers, crimpers and compact pneumatic cutters for industrial or electronic assembly and field service use. XURON's Timeless Engineering Catalog describes over 100 variations of ergonomically designed special purpose shears and flush cutters that feature XURON's patented Micro-Shear bypass technology, which provides a clean square cut using less force than conventional compression cutters.

Featuring product descriptions, dimensional drawings and full-color photographs, the 24-page catalog has a section that explains the ergonomic enhancements designed into the tools, such as cushioned rubber hand grips. Other products include solder resists, desoldering braid dispensers, tweezers and dispensing bottles

The Timeless Engineering Catalog is available free from *XURON Corporation, 60 Industrial Park Rd., Saco, ME 04072; (207) 283-1401, fax: (207) 283-0594.* Or circle Reader Service No. 207.

BARTER 'N' BUY

Number 25 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rt. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the August 1995 classified ad section is June 8, 1995.

PROPAGATION

Number 26 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

Conditions This Month

June should prove to be a fairly good month for propagation on the HF bands, but you must consider three factors: time of year (noise from thunderstorms), low activity (summer solstice) and sunspot cycle (nearing the low point of cycle 22).

All is not lost, however, as June can be a superb month for VHF and also Sporadic E HF propagation.

For best DX chances, choose the days marked G (Good), F (Fair), or F-G/G-F (trending between these conditions), and avoid the days P (Poor) or VP (Very Poor) unless you're a gambler.

Interestingly, those Poor or Very Poor days on the HF bands can mean openings on 6 meters and above, so try them out when the HF bands are not producing results.

As always, there will be surprises, so listen, listen, listen . . .

10, 12, and 15 Meter Bands

Sporadic E propagation on many (G) or (F) days, with good signal strengths of short duration and quick fading. The ionized clouds drift with the high-altitude winds. Expect skip to 1,500 miles or so, and beam across the equator for possible contacts in the opposite hemisphere. These bands will close at sunset.

17 and 20 Meter Bands

Twenty will be best, and sometimes 17 will be almost as good, but not as heavily occupied. If open, the higher-frequency band will provide the longest skip. Twenty will remain open after sunset and sometimes late into the evening. Seventeen will close at dark or shortly after. Possible grey-line DX along the terminator is a bonus.

30 and 40 Meter Bands

Excellent nighttime possibilities on evenings when QRN is low and "conditions" are Good. Thunderstorms between you and your target can make copy difficult if not impossible. Daytime short skip out to 1,000 miles is frequent, and nighttime skip to 2,000 miles or more will occur less regularly. Thirty meters will behave more like 20, and 40 meters will behave more like 80 on many occasions, due to the height of the reflecting layer at that time. Always check the next-higher and next-lower bands.

80 and 160 Meter Bands

Expect lots of QRN. You'll hear very few signals on 80 during the day, and none on 160. These bands are the nighttime bands in summer, and it pays you to keep a sharp ear open after sundown. On particularly good nights with low noise, you will find both long skip and DX on both bands. Avid DXers must be patient, however, because in summer there's almost always noise present. I'd recommend that you use the long summer days and evenings for building up better antennas for these bands, and wait until fall for conditions to improve.

Special Alert

Beware the days 1-3, 6, 7, and 18-21 for possible geophysical upsets. These could include hurricanes, earthquakes, or volcanic eruptions. These won't necessarily happen, but if they do, they will occur on or very close to those days.

Please let me know how these forecasts are working for you at your location. W1XU.

JUNE 1995

SUN	MON	TUE	WED	THU	FRI	SAT
				1 P	2 P-F	3 F
4 F-P	5 F-P	6 P	7 P	8 P-F	9 F	10 F
11 F-G	12 G	13 G	14 G-F	15 F-G	16 F	17 F-G
18 F-P	19 F-P	20 P-F	21 F	22 F-G	23 F-G	24 F
25 F-P	26 P-F	27 F	28 F-P	29 F-G	30 G	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

73 Amateur Radio Today

JULY 1995
ISSUE #418
USA $3.95
CANADA $4.95
A WGI Publication
International Edition

STALK THE DESERT "FOX"!

Build:
- 2m Collinear Vertical Antenna
- DTMF Decoder
- Weather Satellite Reception:
  - Low-Noise Amplifier
  - 5-Foot Parabolic Dish

Learn:
- A Decibel Primer
- DC Power Supplies

Laugh:
- Mikey's Big Adventure

Discover:
- Maldol's Yagi Antennas
- Radio Shack's HTX-212 2m Mobile Transceiver
- Pasokon's Slow-Scan TV Interface

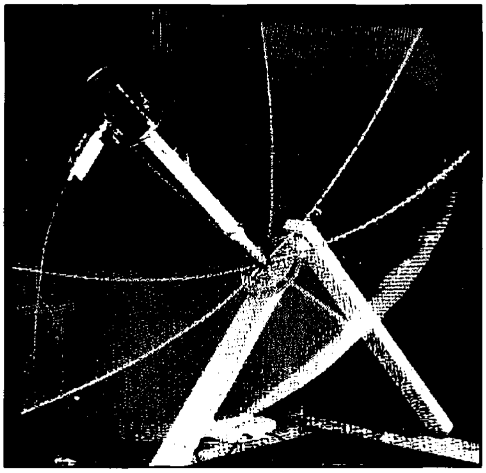
73 Amateur Radio Today

July 1995
Issue #418

TABLE OF CONTENTS

FEATURES

REVIEWS



Wanna receive great weather satellite images? It'll help to have a good dish antenna, plus a low-noise amplifier. Build 'em both and save big bucks. Jim Kocsis shows you how in his articles beginning on pages 10 and 20.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: Although it's built like a tank and crawls through the desert (and even resembles a WWII German helmet), this desert "fox" isn't Field Marshall Rommel. This li'l guy is the "fox" in a radio foxhunt, or perhaps the "T" in a T-hunt. This month's "Homing In" column focuses on the fun you can have tracking radio-tagged wildlife.

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838

Foreign Subscribers

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents ©1995 by Wayne Green Inc. No part of this publication may be reproduced without written permisson of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: You know the drill—you look here, you're committed. It's that simple. You're hereby legally and morally bound to find ways to be found. Make it easy for prospective hams to reach you or your club for info and help getting into amateur radio. Run classified ads, post on local bulletin boards (the supermarket kind or the computer kind), write a weekly/monthly piece for your local paper . . . be creative. (And when something works, tell us here at *73* so we can share with others.) It's "the law." And it's also a good idea!—Nuge WB8GLQ

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

My Dayton Talk

I know you aren't going to believe this, but for the second year in a row the Dayton HamVention program chairman didn't think it would be worthwhile to have me talk. Tsk. I'll bet three or four hundred hams stopped by the *73* booth and asked when I was speaking.

Well, I figured that might happen, so just before I went to Dayton I made a 90-minute tape of what I probably would have talked about if I'd have been asked. I took along a few dozen copies and offered them for $5 each. They sold out in short order. Most of the things I talked about on the tape are the same as I've been writing in my editorials, but perhaps embellished somewhat. As long as my editorials are, and they're the longest in the entire magazine publishing world as far as I know, they are generally as short as I can make them and still get my ideas across.

If you're interested in some good snooze material, send $5 to Uncle Wayne's Bookshelf for a copy of my Dayton nontalk.

The initial response to the tape from those who suckered into buying it at Dayton has been good enough to encourage me to turn on my tape recorder again and pontificate at length on more items of marginal interest. Well, I'll get to that as soon as I finish answering the mail piled up on my desk. My recent trip to Monaco (3A/W2NSD) for the cold fusion conference, followed by the Dayton trip, backed things up for me. Plus it's getting down to the last minute for producing the next issue of "*Cold Fusion.*"

If you buy the tape for your club you could break it into nine ten-minute talks. That'll last you most of a year! Or you could play it in your car and fall asleep at the wheel. Or you could play it over your repeater and bum everyone out.

Even better, Glenn Baxter stopped by the booth and asked if he could interview me for his ham broadcasting service which is heard endlessly on all bands. Figuring he'd do the usual live minute interview I saw no great harm in that. Little did I know that he would tie me down (or was it up?) for about two hours. But then we were talking about me, my all-time favorite subject, so the time almost flew. But not quite. Now I won't have to write that biography so many people have been asking for. Lord knows what he'll do with all that stuff. Maybe he's going to go to a 24-hour a day schedule of broadcasting.

Glenn didn't ask me (but many others did) about my thoughts on the Mala petition to the FCC to end ham broadcasting. My answer to those who asked was the same one I've given most hams when they ask about FCC petitions. Don't ever ask the FCC for restrictions because the chances are that they will oblige, only with ten to a hundred times more than you asked for. The FCC has not, in my memory, managed to break our government's basic rule: Never do anything right.

"I've made it abundantly clear that I am no fan of ham broadcasting. But I'm even less of a fan of asking the FCC to improve our hobby with more restrictive regulations."

I've made it abundantly clear that I am no fan of ham broadcasting. But I'm even less of a fan of asking the FCC to improve our hobby with more restrictive regulations. The fundamental FCC rule is that if something is not prohibited, it is permissible. Secondly, we brag about being self-regulating and self-policing. Okay, let's see some substantiation of this. And if the ARRL, our only real national organization, isn't cooperating in helping to solve our problems, then give 'em hell until they do. The League is like any other bureaucracy, they move only when blasted by a car bomb or something. About the only way you can get their attention is by holding back your membership for a while. Of course, then they might do as they did the last time this happened, and overreact. The last time their membership started to fall off they decided to attract attention by proposing what was laughingly called their "Incentive Licensing" proposal. That's the one that put over 700 ham dealers out of business in one year and 90% of the manufacturers within three years. Talk about a killer proposal! Well, it sure did attract attention.

So, until you can figure out some way to turn Baxter and his broadcasting system down, the odds are that you're going to have to listen to a lot of Wayne Green emanating from Maine. My apologies to the hundreds of hams who stopped at my booth to say hello and found me tied up being interviewed. And interviewed. And interviewed.

Speaking of booth visitors, I do want to thank the hundreds of readers who stopped by to say they're enjoying the magazine. Even my editorials. I'll have to write some more, I guess.

Pregnant Hams

Judging by the hams passing my booth at Dayton, at least 30% are pregnant. Some alarmingly so. I saw hundreds of hams who appear to be at least eleven months pregnant. Mountains of stomachs going by. Well, looking on the bright side, no one was smoking. Inside, at least.

Look guys, I know what fat is all about. I spent a big part of my life being fat. Well, fairly fat, not gross. I varied from 225–250 pounds for years. Then, pardon the expression, I got fed up. I decided about twenty years ago that I'd had enough of being fat. I know what it feels like to want fattening food. To want ice cream, cake, pies, and fries. I know how hard it is to pass up the rolls and butter in a restaurant. After all, you're paying for them, so you'd better eat 'em, right?

Well, I watched these man-mountains waddling by. Hundreds of them. Thousands. Monuments to beer, chips, desserts, Big Macs, Whoppers, and so on. I watched thousands of hams who are substantially shortening their lives besides looking awful. Sure, I've been there, done that.

Contrast that to the endless comments on how good I look now that I've got my weight down. Many compliments. Oh, I still eat ice cream, but only now and then. I get out for a two-mile jog every day and I eat a lot of fruit and veggies, plus a little meat. When Sherry and I go out to eat we order one dinner and two forks. And we often still have leftovers to bring home.

How to lose that weight? That takes one of the most difficult things there is: you have to make The Decision. Once you've decided that you are going to diet and that nothing in the world is going to stop you, you're on the track. There are no secret diets. You just cut back your calories and never go over. No pills. No fat farms. For my size frame I found a 1,500 calorie diet was just right. You don't want to drop more than a couple pounds a week or you'll be chancing a heart attack or something. Take it slow and easy. You spent years building up that gut and it's going to take a few months to get rid of it. Forever.

You'll want to exercise. The best way is to start walking. Take it easy at first and gradually speed up to where you are either walking very fast or jogging a couple miles a day. Walking is better for you, actually. Less strain on the knees.

I took off 85 pounds over about ten months. Once you get used to operating your system on 1,500 calories you won't feel hungry. And once you've made up your mind not to eat junk food, you won't be bothered by it. The mind may call out for candy, but your mouth will do fine on carrots. You'll get to love salads with low-cal dressings. I chop up a head of lettuce, a pound of spinach, a handful of golden raisins and a handful of little pieces of Baby Swiss cheese in a huge bowl, mix it all up, and then keep it in a plastic grocery bag in the fridge for several days, eating a plate of it for lunch every day. I like the low-cal ranch dressing. A couple tablespoons well mixed into the salad at the last minute really tastes great. It's healthy and not fattening. And it's easy to fix.

Once you've dumped all that lard you want to be sure not to put it all back on again, like most dieters do. This means watching your weight. I went from 250 down to 165 pounds, so whenever I find I'm getting back up to around 175 I diet again until I'm down to about 155. It's very helpful if you invest in one of those doctor's scales with the balance beam. This lets you weigh yourself to the nearest quarter pound, thus giving you good feedback every day on your progress.

A lot of the visitors to my booth said I'd helped them stop smoking. I'm glad to hear that. Most of my old friends who smoked are dead. Very few of my WWII submarine buddies that smoked are still alive to come to reunions. Of course, it may be that you don't enjoy life enough or have any goals for hanging around. I do. I have so many things that I want to do that I don't have time to die. If I'm going to keep pushing new technologies with magazines I need to be around for at least another 20 years.

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Howard White VE3GFW Well, after reading your editorials for almost 30 years, I am surprised to have to admit that you are getting old and finally letting technology get ahead of you.

Snail Mail, Indeed. How could anyone so progressive as you fail to capture the essence of the now medium of communication—E-mail? It works. It's cheap. It's accurate. It's efficient. It's easy to use. It's reliable. It's available to everyone. More important, it opens up a completely new medium of communications.

"E-mail? It works. It's cheap. It's accurate. It's efficient. It's easy to use. It's reliable. It's available to everyone. More important, it opens up a completely new medium of communications."

You probably recall Marshall McLuhan's "the medium is the message" theory. E-mail is essentially a completely new and different means of communications. In my long experience with it, I find that E-mail captures the essence of efficient communications that the ARRL (maybe even the "Pony Express") originally tried to achieve. Except E-mail works and it's reliable. For me, E-mail allows me to communicate with members of my family who are scattered around the world. I have made many new friendships with relatives whom I have never met or spoken to. One of my cousins has just written a book because of an Inspiration I gave him through E-mail. Yet I have never spoken to him or seen him In person. I could never have achieved this level of communications with ham radio. As you have preached so long, the elitist and self-destructive policies that prevented access of the younger generations to ham radio have finally achieved their unspoken goals. Ham Radio as I knew it is dead, but not yet fully buried. My children will not ever be hams. Yet they are totally computer literate. With tools such as E-mail and the various chat features they can achieve much of the same communications functions that I used in ham radio. With cellular modems, they have the same flexibility to go mobile without the unreliability of ham radio. Please get an E-mail address. It is a real pain the butt to use snail mail and faxes.

Howard, my E-mail QTH is ProFusion@AOL.com. I don't encourage its use because it's slower than fax to reach me. Fax is the closest service we have that compares with RTTY in delivery . . . and I was doing that back in 1950. Yep, 45 years ago anyone on the net could send a message to anyone else. It would automatically turn on my printer when it was addressed to me and print it out. Then it sent a roger to the sender to confirm reception. Oh, I did E-mail personally for a while, but I found that it encouraged chatting rather than meaningful communications. I don't need pen pals. That's like sitting at a bar talking with people. My wife Sherry handles my E-mail for me. She enjoys AOL and Prodigy and I get the printouts. I feel sorry for the people who spend hours a day fighting small battles with small groups via the online services. I get the ham and cold fusion stuff, but seldom bother to enter the fray.

One thing your kids won't get from their computers is the incentive to learn about electronics and radio theory. Can they design and build a circuit for their computers? They'll be doing the equivalent of standing on the corner chatting with people about little and missing the excitement of communicating through a ham satellite to someone in Russia, or snagging a voice contact with someone in Lesotho (where my call is 7P8CD) and finding out about what's going on there. Like the ham who has a small deer as a house pet. Or the fun of building a one-watt CW rig and working someone in Australia with it. Sure, tell me about E-mail.

Wayne

J. Frank Brumbaugh KB4ZGC I have been reading quite a bit In the ham magazine "Letters" columns wherein hams (?) mouth paeans upon Internet as making QRM/ORN-free QSOs with people all over the world. All one needs is a telephone, a modem, a computer, a monitor, and possibly a printer.

The cost of the necessary equipment probably equals, and In some cases, exceeds, the cost of the average ham radio station. But if all one desires Is to be able to have QRM/QRN-free conversations with persons all over the world, all he *needs* is a telephone!

While I agree that Internet, if one has the knowledge and equipment for access, can be a wonderful source of knowledge, and does allow "teletype type" conversations—QSOs—without interference. But where Is the challenge?

I like ham radio for the challenge, because there *is* QRM and QRN and QSB, and because propagation is so variable. One never knows whom one might contact, nor how interesting the resulting QSO may be. One reads the fist, or hears the voice, of the other party, and learns more about them than can be deduced from print appearing on a monitor. Ham radio is far more personal a communications medium than the Internet.

Perhaps because I've been a ham since 1949, and have designed and built a large number of rigs and accessories, plus modifying commercial equipment to make operation easier or better, I still enjoy the smell of hot solder, of designing or modifying and constructing accessories and test equipment. I also enjoy experimenting with antennas. All this fun goes out the window if one becomes simply a typist connected to the Internet.

I sit here typing this letter, which may or may not see publication. I am not having fun—that comes when I turn the rig on and explore the bands, usually trying to make a few contacts and hoping they will develop into more than a mere exchange of signal reports, rigs, and QSL promises; and many do. Fun, also, is when I open up the rig and add a modification or two, to make it serve me better. Fun is when I need a piece of test gear and design and build what I need, at a much lower cost than purchasing a commercial unit which, in all probability, has features I must pay for but lack the need for them.

Yes, Internet has Its place, and one does not need a ham license to utilize it. But ham radio is not only a challenge but also is fun, and without both challenge and fun, life would be very dull.

I do not have a computer et al; I do not need them. I do have ham radio, both QRP and a 50-watt rig, and these I need! Enjoy Internet; I wish you well. But, please! Enjoy ham radio while we still have it.

"I still enjoy the smell of hot solder, of designing or modifying and constructing accessories and test equipment. I also enjoy experimenting with antennas. All this fun goes out the window if one becomes simply a typist connected to the Internet."

Edward Slabe N8TQP, Gahanna OH Wayne, I have been subscribing to *73* magazine for three years now, as long as I have been licensed. Each month I look forward to reading your editorials.

I have built many of the projects from your articles. You have a great magazine and it seems to be getting better all the time. Thanks!

I have read the book *Cross Currents* and found it thought-provoking and very informative. I have ordered the book *Kinship With All Life* and am waiting for it to come.

Thanks again for the great articles that you provide In *73*.

Donn S. Fishbein, MD, N8UWD, Celina OH Wayne, I've enjoyed your column for years. While most of the questions you pose to us readers are imponderable, I can offer my answer to a few you asked in your October 1994 column.

We can retain memory because cells in the human central nervous system, unlike most other cells in the body, have virtually no turnover or ability to divide or regenerate.

What about that 90% of DNA that Isn't "involved with the blueprints for the current model human being"? This is a tougher question, but part of the answer is that much of it is antiquated or "junk" DNA that remains from evolutionary development. At a cellular level, it's much easier to switch a gene off than to delete the entire DNA sequence.

Keith Barze W4TXK You do write great editorials! (However, I'm not sure they get much more response than mine.).

Hams are tough to "move," and as you predict, most old timers give it the ol' "I had to learn the code and take a bunch of tests to get where I am; so should everybody else!"

Only a few of the older—and quite a few of the newer—hams take the liberated view of no-code, single license (or 5 wpm, if necessary) . . .

I've enjoyed *73* since you started It—1969, wasn't it?—but must confess I'm enjoying *Radio Fun* very much! (Almost better than *73* right now.) But keep up your good work . . . I appreciate all you've done and are doing for ham radio! 73!

Larry Lane Although not a practicing ham, I've enjoyed *73* for several years. Unfortunately I believe ham radio is doomed. The precedent of auctioning the airwaves (or delivering them to your political supporters) has now been accepted. Your spectrum is too valuable to government and the global communications conglomerates.

It will not be a clean, quick kill. The spectrum allocations will be whittled away bit by bit. You'll find new fees required for specific frequency use, increasing fees for higher output levels, antenna permit fees, fees for mobile operation, and so on. If these actions don't entirely decimate the ranks, amateurs will be painted as a threat to national security due to the "unregulated" international nature of your communications.

Addition of a million or two new hams might slow, but not stop, the process. Ultimately we'll all be relegated to paying exorbitant fees to communicate on heavily monitored government/commercial links.

What the hell; count me in as the first of those million or two new hams. Now to find a V.E. in the area.

QRX . . .

Number 3 on your Feedback card

Photo Search

Shoot our next *73 Amateur Radio Today* or *Radio Fun* cover photo! Suitable subjects might be ham gear, amazing antenna arrays, or better—your own catchy ideas. We prefer color prints (from 35mm or larger formats) that are vertically oriented, sharply focused, not too "busy," and (for *73*) leave extra room at the top and left side. Send 'em to *Photo Search, 70 Route 202N, Peterborough NH 03458*, with a brief description, your full name and callsign, and permission to publish. We can't return photos without an SASE. If it doesn't make the cover, we might find a spot inside. Selected photos earn you a free subscription or renewal. Good luck!

Dallas Hailstorms

Dallas County RACES sprang into action late on Friday May 5th as a series of ferocious hailstorms shattered windows, pockmarked cars, and collapsed buildings across the Dallas-Fort Worth area. Thirteen people are confirmed dead. Four others are missing and presumed dead and over 100 others were injured. The four missing people were apparently swept away in a storm drain in downtown Dallas.

As the storms approached, Dallas RACES went on tactical alert. The local Skywarn system was activated with hams feeding information to the National Weather Service in Fort Worth. Others provided police, fire, and emergency services with hail and flooding information.

Several ARES groups were also activated with at least one group of hams reportedly dispatched to the local Mayfest. Mayfest is an annual outdoor festival in West Fort Worth and many of the injured were attending this event.

Auto dealerships in the Dallas area reported damage to new cars from the hail that reached the size of baseballs. The Fort Worth police department's 45 brand-new cars were also damaged by the hail, which was accompanied by winds of over 70 mph and torrential rains.

Damage to the area was estimated at $250 million. The exact number of hams involved in this emergency operation is not yet known. *TNX Newsline.*

Omega Radio R.I.P.

Listeners to *Newsline* on the satellite-delivered program "This Week in Amateur Radio" were surprised last week when all they heard was dead air. This is because the Omega Radio Network, which provided satellite time for "This Week in Amateur Radio" and several other hobby radio shows has gone silent.

Steven Anderman WA3RKB and George Bowen N2LQS produce the show, and say that they are looking for a new satellite home for their program. In the meantime, they will be feeding it out on 160 meter AM using the facilities of Vern Jackson WA0RCR and his 160 meter Gateway Net. If you know of some inexpensive or free time on a C-Band geostationary communications satellite, please give George and Steven a call at (518) 383-3665. In our book, this is a very worthwhile service that deserves your support. *TNX Newsline.*

Wayne and Sherry at Dayton, 1995

OK, who else has been exhibiting since 1955? *TNX Bill Brown WB8ELK.*

Details on HF Data

As reported last week, the FCC has released its Report and Order in PR Docket 94-59, concerning HF digital communications in the Amateur Radio Service. The new rules, effective July 1, 1995, permit automatically controlled HF RTTY and data stations to communicate with one another in the following segments: 28.120 to 28.189, 24.925 to 24.930, 21.090 to 21.100, 18.105 to 18.110, 14.095 to 14.0995, 14.1005 to 14.112, 10.140 to 10.150, 7.100 to 7.105, and 3.620 to 3.635 MHz.

The new rules also permit manually controlled stations to initiate communication with automatically controlled HF RTTY and data stations. In this case the automatically controlled station may use any frequency authorized for such emissions, but may occupy a bandwidth of no more than 500 Hz.

Automatic control must cease upon notification by an FCC engineer in charge that the station is transmitting improperly or causing interference to other stations.

The FCC said it recognized the concerns of those who opposed the proposal on grounds that such operation could interfere with other amateurs, but that it believed the provisions adopted would be adequate to minimize such interference. *TNX Newsline.*

Taxi Sats

Amateur radio satellite operators in Spain have asked that nation's telecommunications regulatory agency to stop taxi companies in Madrid from using the satellite frequencies for their communications. Illegal taxi communications are reportedly making ham radio satellite communications unusable in Spain and in other parts of Europe when the satellite is visible. The taxi services are not actually using the hamsats to communicate. Rather they are illegally operating their dispatch services on frequencies reserved for amateur radio satellite operations. Several European amateurs have offered ideas on how to deal with the problem, but government assistance has been very slow. *TNX Newsline.*

The *Ham Band* Tours America

Musicians Andrew Huddleson G3WZZ/OZ1XJ/3D2AH from Northern England and his XYL Lissa Ladeforged from Arahus, Denmark, are touring America following their successful tape and CD recording of *Seek You*, a collection of country songs about ham radio they recorded in Nashville. They have recently toured Holland, Denmark, Hungary, Britain, and New Zealand. Andrew also operated from the rare DXCC island of Rotuma. Their recordings feature the skills of 15 of the finest Nashville musicians, including legendary pedal steel player Buddy Emmons, pianist "Pig" Robbins, and drummer Kenny Buttrey who played on Bob Dylan's Nashville albums. Shown in the photo are *Ham Band* members Andrew G3WZZ, his XYL Lissa, and one of the band's many fans, Ken Miller K6IR, of Rockville, MD. *TNX Ken Miller K6IR.*

Dish Antenna for Weather Satellite Images

Build your own 5-foot parabolic dish for 1691 MHz.

by Jim Kocsis WA9PYH

My interest in weather satellite imagery started late in 1984 after seeing some pictures in *73* magazine[1]. Since then I've copied visible and infrared pictures from polar orbiting satellites (VHF) and all sorts of images via HF[2]. None of the pictures from those sources were as interesting as those I saw in articles showing images directly from the geostationary satellites. The polar orbiting satellite images don't display geographical borders[3] so you don't know exactly where the "weather" is located on your picture. The pictures from the geostationary satellites relayed over HF are fairly good, but: (1) the signal is subject to fading and static from man-made sources and thunderstorms (when you need it most and when the most interesting images are being sent): and (2) cloud and infrared imagery is available only once in awhile, because they mostly send maps of temperatures, pressures, etc. I wanted the near-continuous imagery that is only available from the originating point. After acquiring a microwave downconverter at the 1994 Dayton Hamfest and doing a lot of research, I figured that a 5-foot dish should have enough gain for obtaining good solid signals on a reasonably sensitive LNA/downconverter/scanner combination.

Why build a parabolic dish antenna? Just being a ham, I'm interested in antennas. I've built some that worked quite well and some that didn't. Until now at least, all of them worked to some extent, since some of the desired signals are very strong. Since the signals from the geostationary weather satellites are usually weak, the antenna is a critical component, and must be designed and built properly. Commercially available dish systems cost several hundred dollars on up—this did not set well with my ham radio "upbringing," which says it is ham tradition to build rather than buy. A 5-foot diameter commercial, solidly made dish that I obtained for free didn't work at all (more on that fiasco later!). A loop yagi for this frequency costs $100+. One manufacturer of loop yagis said performance is only "good" with some of the best LNA/downconverters—he said a dish is the preferred approach. After considering all these factors (price, performance, nonavailability of a surplus dish with the correct curvature) and the desire to *build something*, I could see another project on the way!

Technical

For a given wavelength, the feedhorn has a minimum length and diameter. An excellent item to use for a feedhorn for 1691 MHz is a two-pound coffee can. Again ham tradition comes into play: a coffee can is free, so, for reasons of thrift (not cheap—just as Wayne Green says), you should use one. To obtain optimum performance the dish and feedhorn should be "matched." See Figure 1.) Now the problem: All references I could find said the feedhorn should illuminate the dish such that the signal at the edge of the dish is 10 dB down from the level at the center, but what *is* the illumination angle of a coffee can? Using a coffee can feedhorn at 1691 will provide an illumination angle of 122 degrees. (This critical information I didn't have at first). I figured I should build the largest dish that I could easily handle and that would provide a fair amount of gain (20-25 dB). The diameter and the illumination angle together determine the depth (curvature) of the dish. This curvature is also referred to as the f/D (focal length to diameter ratio). For a 5-foot diameter dish and an illumination angle of 122 degrees the f/D is 0.424 and indicates a relatively flat dish—deeper dishes have lower f/D ratios (0.3 or so). All the dishes I could find had f/Ds of 0.3. I used a coffee can feedhorn with a 0.3 f/D, 5-foot diameter dish and heard nothing. After carefully studying my first attempt I found that the feedhorn was grossly under-illuminating the dish, resulting in only about 1/2 of the dish surface being used. According to several sources[4, 5] it is very hard to design a feedhorn that would fully illuminate a dish with an f/D of 0.3; however, a common approach is to use scalar rings[6]. Scalar rings are an add-on around the perimeter of a circular feedhorn that spreads out the "wavefront," increasing the illumination angle. At our frequency the scalar rings would be approximately 14 inches in diameter—this reduces the amount of area of the reflector that

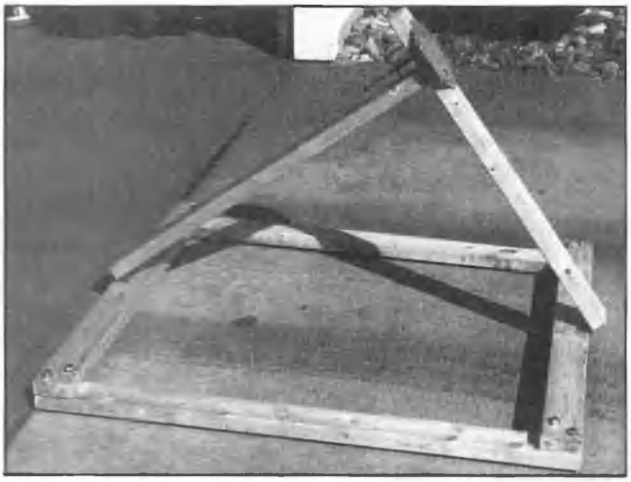


Photo A.

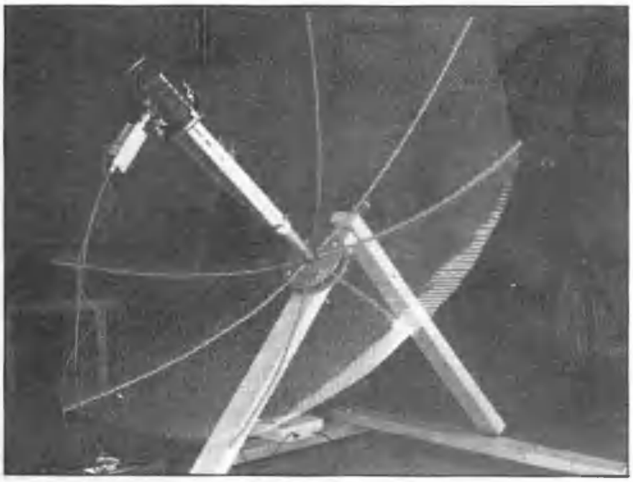


Photo B.

```
10 FOR X = 0 TO 30
20 LPRINT X, (INT(10 * (( X * X ) / (4* 25.47 )))) / 10
30 NEXT X
```

X	Y
0	0
1	0
2	0
3	0
4	.1
5	.2
6	.3
7	.4
8	.6
9	.7
10	.9
11	1.1
12	1.4
13	1.6
14	1.9
15	2.2
16	2.5
17	2.8
18	3.1
19	3.5
20	3.9
21	4.3
22	4.7
23	5.1
24	5.6
25	6.1
26	6.6
27	7.1
28	7.6
29	8.2
30	8.8

"X" is distance in inches from center of pipe.
"Y" is amount of curvature in inches.

Table 1. X-Y coordinates of curve.

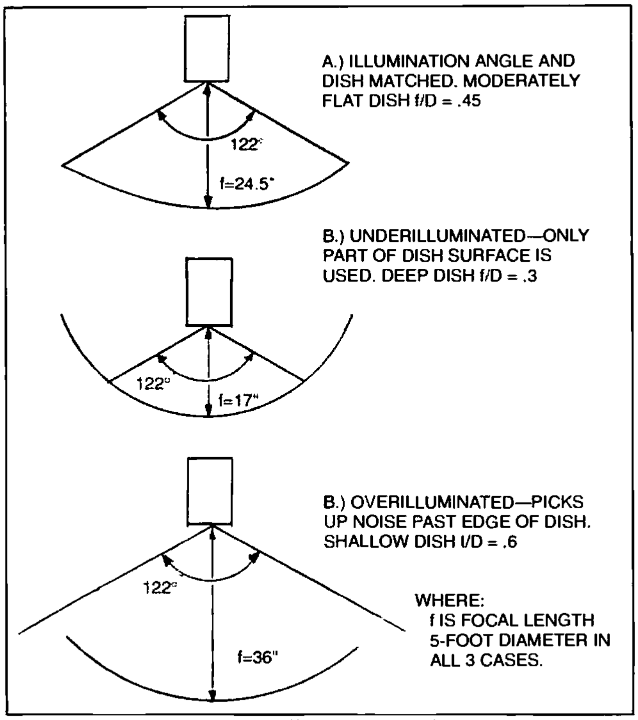


Figure 1. Illumination angle.

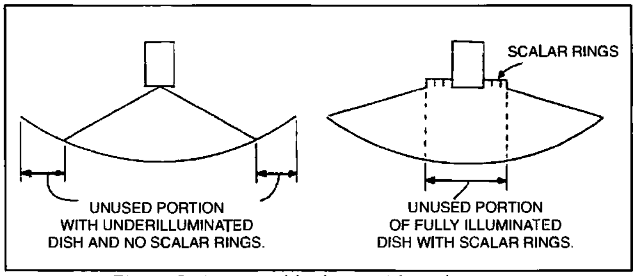


Figure 2. Aperture blockage with scalar rings.

can "see the satellite." Using scalar rings presents the same problem as before: The entire reflecting surface is not being used. (See Figure 2.) (Scalar rings can be seen on lots of the TVRO dishes—look back into the feedhorn. They are the concentric rings around the opening of the feedhorn. They work well at TVRO frequencies [3.7-4.2 GHz] since they are very small at those higher frequencies and thus block very little of the reflector surface.) The bottom line: For a 5-foot diameter dish and an illumination angle of 122 degrees you need an f/D of 0.424 for optimum performance. See Table 2 for the method used to determine the curvature. Since I couldn't find a dish to meet these requirements, I decided to build one.

Construction Details

First gather all the parts you need (see the Parts List). The coffee can must have the dimensions shown. It *must* measure 5 inches in diameter and 6.5 inches long. There are some other sizes of two-pound (approx.) cans around; these will not work. The round aluminum plates and webs must have all the holes drilled accurately. (See Figures 3 and 4.) Next, make a fixture for bending the webs. Make up a small metal bracket that will secure the end of each web at the corner of the board so that webs attached to the bracket will be above the board surface by approximately 1 inch—this space will allow you to get the tubing bender between the board and the tubing when you bend the webs. (See Figure 5.) A curve is then drawn on the board that matches the required curvature of the reflecting surface. (See Table 1 for the X-Y points of the parabolic curve.) Make the bracket out of 1/8-inch or thicker aluminum or steel plate so the bracket doesn't move when you start the bending—you need a rock-steady anchor while bending the tubing. Make the first couple of inches of bend by hand, since the tubing bender won't be able to grip the tubing near the bracket. The remaining bends can then be made using the tubing bender. The two holes at the end of each web should be the smallest possible—these holes are *the* weak point in the entire design. I used 6-32 screws, but recommend 4-40 size hardware now that I have built the dish and see some ways to improve it. After mounting the webs to the plate, we need to convert the bending board to a template to see if the webs still conform to a smooth parabolic surface. Cut the board along the curve you used to guide yourself when you were bending the webs. A saber saw will work fine. Slide the template around the steel pipe and check the webs to see that they haven't been bent away from the parabolic curve. All webs should conform to a parabolic shape by plus or minus 7/8 inch.

Next, the individual panels must be cut from the metal cloth. Warning: *when you unwrap the metal cloth be careful that the roll doesn't spring apart and cut you!* It can injure you before you know what happened. I recommend a face shield, gloves, and a thick sweatshirt, which should protect you very well—safety glasses as a minimum. Also, keep children and pets clear of the metal cloth after it is unrolled. The garage is an excellent place to do all the cutting. Be careful, the edges you cut are sharper yet—my hands looked like I was wrestling with a jungle cat after cutting my first panel! The most important point is that you should cut each panel too large rather than too small—don't scrimp here! If you cut a panel too small you can't stretch it and you will have to throw it out (Wayne wouldn't like wasting *his* money would he?). Cut out a template, using heavy paper, to the dimensions shown in Figure 6. Lay this template on a flat portion of the

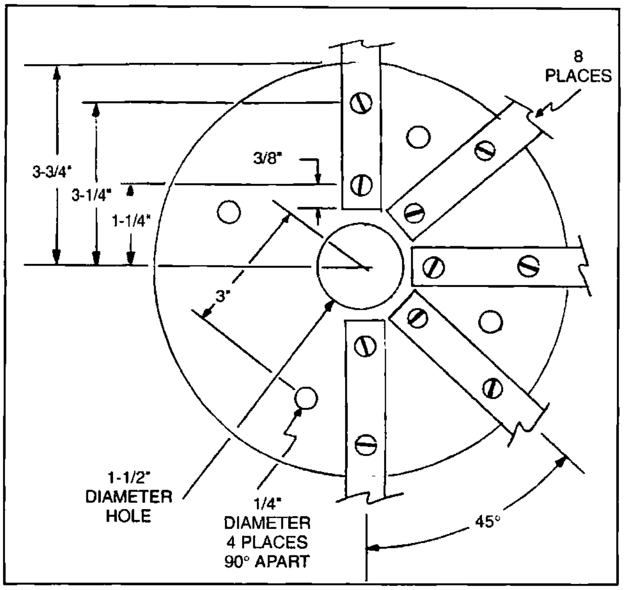


Figure 3. Front plate layout.

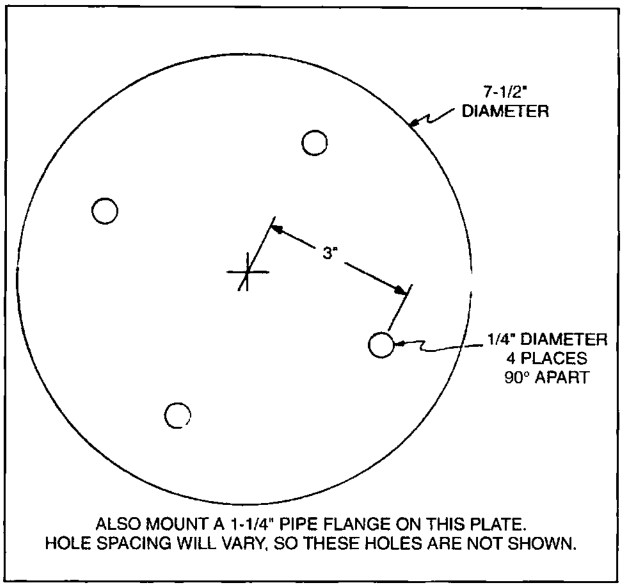


Figure 4. Rear plate.

metal cloth and cut it using side cutters. I cut the panels over several weeks. Since steel wire is much harder than the copper we are used to cutting, you will probably have blisters on your fingers after cutting two or three panels. Each panel should be curved to conform to the required shape *before* attaching it to the webs. If it is too flat you won't be able to stretch it to the required curvature. If it is too curved you can "pull it tight" to get the required curvature, so curve it a little too much instead of too little. Anchor each side of the panel at the unattached end of each web with a large alligator clip. Begin by securing the panel with 6-inch lengths of steel wire, passing the wire around the web, and a soldered junction that touches the web—this will prevent a junction from being pulled apart. (See Figure 7.) Twist the steel wire until the metal cloth is tight against the web, then cut it so that a few twists remain. Bend the twist down to get it out of the way. When doing the wiring, I hung the plate and web assembly from a shelf. I recommend this since it eliminates having to reach over the dish if you were to assemble it on the floor. (See Figure 8.) Hanging the dish as shown allows you to stand up or sit on a stool while attaching the panels. Continue adding steel wire until you have the panel secured every 2 to 3 inches along each web. The last panel is the hardest to wire since you won't be able to reach between any unpanelled webs, but by this time you'll be an expert! Most panels will need some pushing and pulling to get them within the ± 7/8-inch tolerance from the required curve. If a panel is so very curved *behind* the desired curve that you can't push it into shape, you may have to use another technique. The technique is simply to use a pair of large needle-nosed pliers to pull a panel "tighter." Grab each of the wires of a pane that goes side-to-side (web-to-web) and give it a 90-degree twist. (See Figure 9.) Once you get all the panels to within the ± 7/8-inch tolerance in most areas, you are done with the most difficult part. Deviations from a perfect parabola are preferably both plus and minus, and not progressively plus or progressively minus. (See Figure 10.) Next, mount the flange and its pipe at the center of the rear round plate, using some small bolts and nuts. There isn't much weight to support, so 8-32 size hardware is adequate. Next, bolt the two plates together using the 1-inch sections of tubing with 1/4-20 bolts passing through them. (See Figure 11.)

Next comes the construction of the feedhorn. (See Figures 12 and 13.) First, cut the copper tubing to the required 1.375-inch length. You may have to drill out the center of the tubing if you used a tubing cutter since the cutter tends to close off the tubing ID. Solder the tubing to the N connector center conductor—keep it straight and make sure you have a good, clean connection. Remove any solder on the outside of the tubing since copper is a much better conductor than solder at this frequency. Remember that *all* of the signal travels along the outside of this short length of tubing. Next cut a hole for the N connector in the side of the coffee can 3 inches from the closed end. The metal can is so thin that drilling is very difficult, so if you have or can borrow a chassis punch to make the hole for the connector, use it. If you cannot get a chassis punch, then drill a hole somewhat smaller than needed and file the rest. I tried drilling the hole the required size and ended up ripping the can so badly I had to discard it. After you have a smooth round hole, use a wire wheel to remove all paint on the outside of the can near the hole. Also clean up the edge of the N connector flange where it will be soldered to the can. Drill the four small holes in the can and mount the connector with four small bolts and nuts. Tighten the screws so the connector flange is tight against the can. Using a

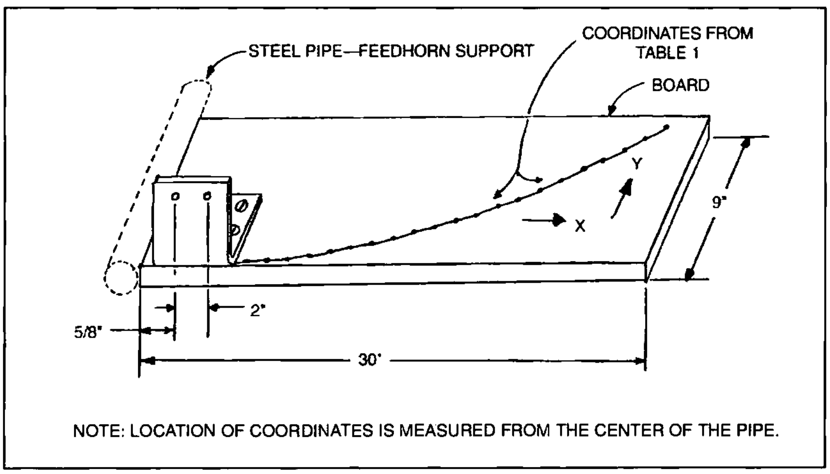


Figure 5. Web bending fixture/template.

propane torch, solder all around the flange so there is one continuous bridge of solder between the connector and the can. I used the rosin core solder that I use on all my electronic work, and some extra soldering paste to make sure that I had a good clean connection. Use alcohol to clean all the flux from the area after you are finished. Next cut the PVC pipe to a length of 19 inches. Make two cuts at one end, approximately 2 inches long, 90 degrees apart. At the end opposite the cuts, mount the nylon "L" brackets on the PVC pipe. The "L" brackets I used came from a tie strap use for cable bundling. They have an extra piece that is used to attach the cable bundle to a chassis with a small bolt. Cut and discard the tie strap. The round hole is used for attachment to the PVC pipe. The slot is used for attachment to the Plexiglas plate. (See Figure 12.) This method of supporting the feedhorn is a slight variation on a design described in the *Weather Satellite Handbook* by Taggart—I had access to nylon parts and used them. Slide the PVC pipe over the steel pipe and adjust it so that the edge of the can is 24.4 inches from the center of the reflector surface. (See Figure 13.) The focal length of this dish is 25.5 inches. The focal point is the location that all incoming energy is focused upon. This point should be 1.1 inches *inside* the can for best operation. Secure the two pipes together with a hose clamp.

I've included a diagram of a mount that I used to support my dish. It's simple, very inexpensive, and it works. (See Figure 14.) Attach the whole dish assembly and aim the dish at the desired satellite. GOES 8 is the best satellite to aim at since it is the newest satellite and is running full power. As of late December 1994, GOES 7 is running 1/4 power (a 6 dB disadvantage) and will be more difficult to receive full-quieting signals from when using a marginal system. GOES 8 is running vertical polarization, which means that the copper stub in the feedhorn should be pointing straight up or straight down. Since this dish has a beamwidth of 8 degrees, aiming isn't too critical. With my home-brew LNA, an unknown surplus downconverter and a scanner-type receiver, I was able to receive a full-quieting signal from GOES 8. The LNA isn't real "hot" (the noise figure is calculated at 1.7 dB and the gain was measured at 39 dB). Moving the feedhorn in and out or side-to-side 3 inches made no difference in the signal; it stayed full quieting. This shows that the system has plenty of reserve gain, but you should still adjust the feedhorn spacing for a peak. To peak the spacing, first reduce the signal level by turning the dish slightly to one side until the signal weakens. Then adjust the feedhorn spacing for a peak. Last, after perform-

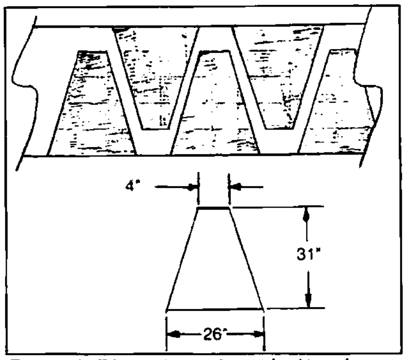


Figure 6. Dimensions of panels. Note how to minimize waste of metal cloth.

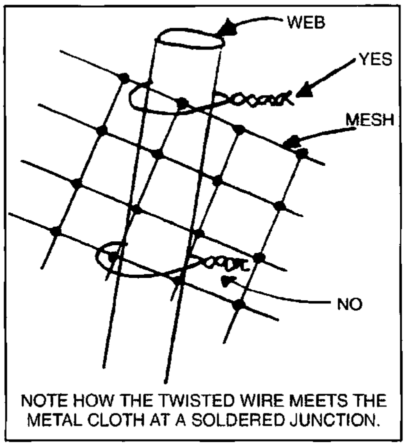


Figure 7. Securing the metal cloth to a web.

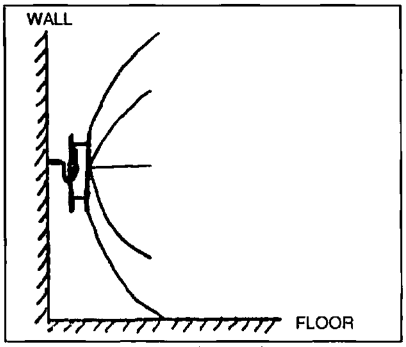


Figure 8. Hang the plate/web assembly on a wall to make it easier to work on.

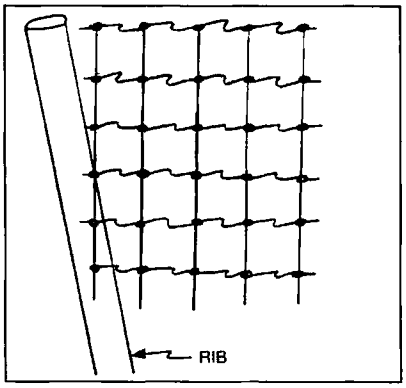


Figure 9. Appearance of metal cloth after twisting it to get the required dish curvature.

1.) $< BAC = 61°$ and $< CBA = 90°$ therefore $< BCA = 29°$ where < means "angle formed by ...."

2.) $\text{TAN } 29° = \frac{AB}{BC}$

3.) $.5543 = \frac{AB}{30"}$

4.) $AB = 16.63"$

5.) General Dish Formula: $\text{Focal Length} = \frac{(\text{Diameter})^2}{16 \times \text{Depth}}$

$f = \frac{D^2}{16d} = \frac{(60)^2}{16 \bullet d}$

Where D = diameter = 2 x BC
d = depth = BD
f = focal length = AB + BD

6.) $f \bullet d = \frac{3600}{16}$

7.) $f \bullet d = 225$

8.) But: $f = d + 16.63$
So: $(d + 16.63) \bullet d = 225$
$d^2 + (16.63 \bullet d) - 225 = 0$ Solve quadratic equation for d

General Quadratic Equation: $ax^2 + bx + c = 0$

Solution To Quadratic Equation: $X = \frac{-b \pm \sqrt{b^2 - (4ac)}}{2a}$

9.) $d = \frac{-16.63 \pm \sqrt{(16.63)^2 - (4 \bullet 1 \bullet (-225))}}{2 \bullet 1}$

10.) $= \frac{-16.63 \pm \sqrt{276.56 + 900}}{2}$

11.) $= \frac{-16.63 \pm 34.3}{2}$

12.) $= +8.835", -50.93"$ (-50.93" is not possible so d must be +8.835)

Table 2. Calculation of parabolic curve.

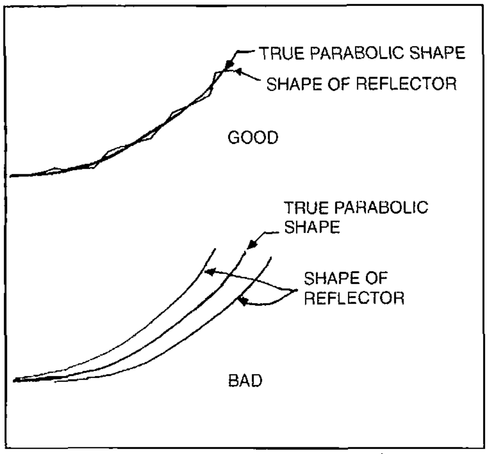


Figure 10. Deviation from a true parabolic curve should be both positive and negative, not all positive or all negative.

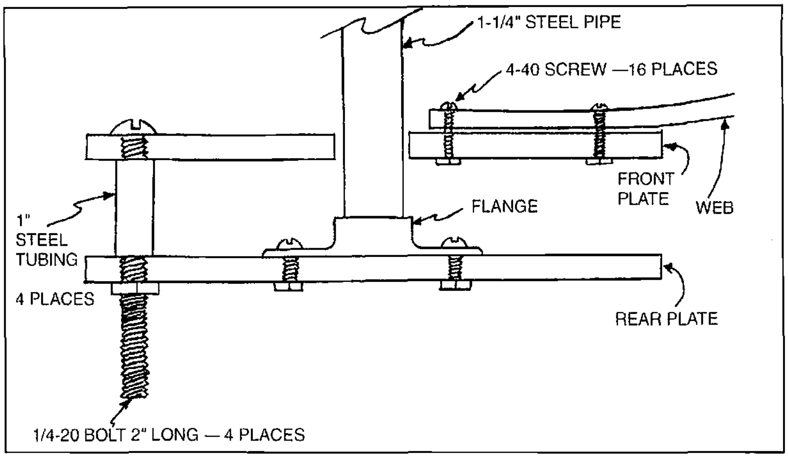


Fig 11. Front & rear plate, flange assembly.

ing all the tests, I noticed that half of the dish was "looking" through our garage overhang. We're not allowed to have satellite dishes in our neighborhood, so I did all my test "looking" out the overhead garage door. I plan on mounting this antenna completely indoors, so this was a good test, even though it was unplanned. The extra gain may be needed in my installation. The feedhorn is a generic design—I've seen it described in *QST*, the *Weather Satellite Handbook* (highly recommended reading!) and the *RSGB* handbook. The design of the dish is my own and can be changed as you see fit; just keep the curvature within the ± 7/8-inch tolerance. I'm not sure how long my dish would last outside—we occasionally have wind gusts up to 60 mph in our city, and I doubt this dish could withstand a wind that high. If I were to place this dish in "the elements," I would consider putting some kind of potting inside the webs to strengthen them. Also, you should consider drilling a small hole at the end of each web and passing a wire through all around for extra support of the webs. And spraying the entire dish with Krylon brand acrylic spray will keep the steel parts from rusting. (I've sprayed this on the galvanized steel parts of a telescoping mast, and 20 years later it still shows no signs of rusting!

Continued on page 18

PARTS LIST

Quantity	Description
1	1-1/4-inch pipe flange
1	1-1/4-inch O.D. pipe, 14 inches long
2	Aluminum plate, 7-1/2-inch diameter x 1/8-inch thick
8	Aluminum tubing, 3/8-inch diameter x 31 inches long, and a suitable tubing bender
16	4-40 nut, screw, star washer combination
4	1/4-20 x 2-inch bolt with nut
4	Steel tubing, 1/4-inch I.D. x 1 inch long
1	PVC pipe, 1-1/4-inch I.D. x 19 inches long
1	Pipe clamp, 1-1/2 inch
1	Plexiglas, 6-inch diameter x 1/8-inch thick
6	Nylon brackets (see text) from tie straps
6	Nylon bolt and nut, 4-40 x 3/4 inch long
1	Coffee can, 5-inch diameter x 6-1/2 inches long
	Flange mount type N connector (silver plate—*not* bright, shiny type!)
1	Copper tubing, 3/16-inch O.D. x 1-3/8 inches long
4	4-40, 1/2-inch bolt and nut—attaching N connector to coffee can
1	Roll of 1/2-inch metal cloth, 36 inches wide x 18 feet long
1	Roll of steel wire, #20, 50 feet
1	Piece of solid wood (*not* plywood), 3/4-inch x 9 inches x 31 inches
Mount	(optional)
3	Building grade 2 x 4, 8 feet long
	Hinges, wood screws as required
8	3-inch nail
1	Aluminum plate, 7-1/2-inch diameter with holes to match rear plate

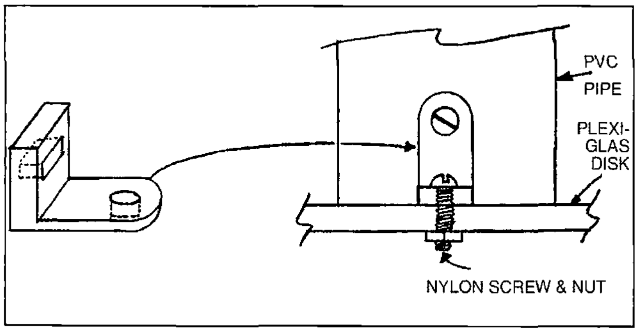


Figure 12. "L" shaped bracket to attach PVC pipe and coffee can to Plexiglas disk.

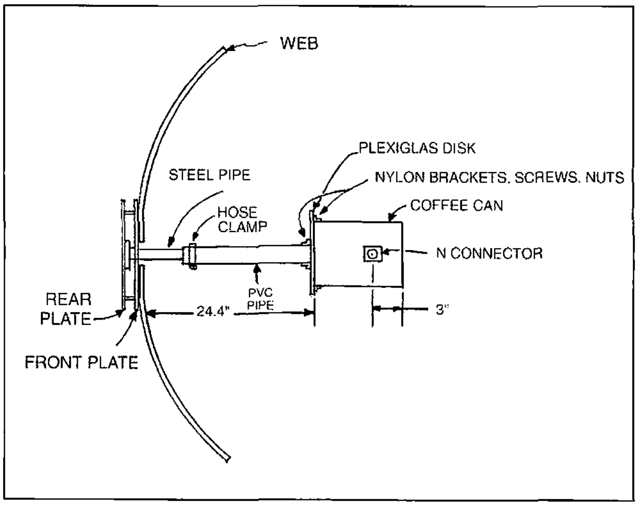
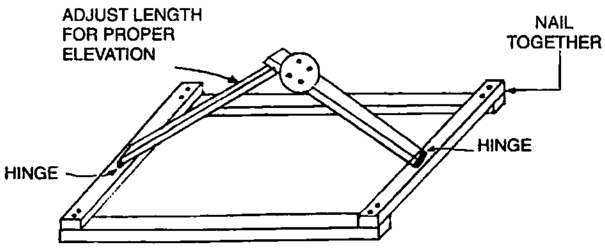


Figure 13. Overall layout of dish components.

Dish Antenna for Weather Satellite Images

Continued from page 16



NOTE: 3—8' x 2" x 4" CUT IN HALF.

Figure 14. Simple dish mount.

I learned a lot designing this dish. I especially appreciate the help of Norm WA9HUV and Bob WA7MOV, without whose help I could not have determined the proper illumination angle of the feedhorn, and thus optimized the curvature of the reflecting surface. Copies of all my notes are available if you send a large SASE with enough postage for 4 ounces. The techniques I used came from the sources shown, but I combined the best of each to design an antenna that is lightweight, easy to produce and provided the maximum amount of gain. The *Weather Satellite Handbook* didn't optimize the curvature of the reflecting surface by matching the illumination angle and the dish diameter. The article in *Ham Radio* magazine[7] required a fair amount of mechanical machining that I was not capable of doing myself.

The following people were very helpful while constructing the dish: Dave WD8CZM, for helping to verify the formulas; Roger WA9OKC, for general help on microwave techniques and requirements; Bob N9NRW, for cutting the Plexiglas plate on the feedhorn; George Pullin, for helping machine the round aluminum plates; and my Dad, for teaching me a long time ago to tackle a big project like this one piece at a time instead of trying to do it all at once. I highly recommend reading as many of the references listed as possible[8]. They were a real education for me. (A word for those of you who don't think you can successfully build a dish like this: How accurate does the surface have to be? You can deviate 1/8 of a wavelength [7/8-inch at this frequency] with no noticeable degradation in performance. Do you think you can hold this tolerance? Sure you can! Just take . . . your . . . time!). If you decide to build this dish, I would appreciate hearing from you on how it works! ■

References

1. "Color Computer SSTV," parts 1 and 2, *73 Magazine*, November and December, 1984.
2. Using a SSB receiver tuned to 8.080, 3.357, etc., MHz.
3. There is some software available from OFS Weatherfax that does superimpose geopolitical maps on the picture data that you obtain from the polar orbiting satellites.
4. *Satellite Experimenter's Handbook*, ARRL publications.
5. *The ARRL UHF/Microwave Experimenter's Manual*, ARRL publications.
6. *Satellite Experimenter's Handbook*, 1985 edition, pages 9–30.
7. "A Home-brew Microwave Antenna," *Ham Radio Magazine*, September, 1982.
8. Other references:
   ARRL Antenna Handbook;
   The Weather Satellite Handbook, by Ralph Taggart (highly recommended reading);
   "Cylindrical Feedhom for Parabolic Reflectors," *Ham Radio Magazine*, May, 1976;
   Technical correspondence, *QST*, March, 1980.

A Low Noise Amplifier for 1691 MHz

Build this LNA for weather satellite reception.

by Jim Kocsis WA9PYH

The signals from the geosynchronous weather satellites are very weak after traveling the 22,500 miles to earth. The satellites' transmitter power is only 5 watts—not a lot of power for the distance. The signal at ground level is on the order of 0.05 microvolts. Consider that your typical 2 meter rig has a sensitivity of 0.15 microvolts for a nearly full-quieting signal—the signal from a weather satellite is 1/3 this level and at a frequency approximately 10 times higher. High sensitivity at this high frequency is difficult to attain (read: expensive)—check the price of a typical LNA for this frequency—prices start at $150 and go up!

Sure, you can build one—but you must match the input and output impedances of the amplifying device (typically some kind of FET) to 50 ohms. The impedances are usually complex and thus will have capacitive and/or inductive components plus resistive components that must all be transformed to as near 50 ohms resistive as possible. This is so you can obtain the gain and noise figure the manufacturer of the device shows in his specifications. I spent literally months reading about "S" parameters, Smith charts, stripline matching networks, etc., that tell how to design the required matching networks. I even designed an FET-based LNA that was very complex—never tried it out, though. It required two power supplies: one for the drain and one for the bias supply for the gate. The power supplies had to be turned on and off in the correct order or else—POOF!—there goes the FET at $13!

At work I receive various magazines that advertise components for the commercial and military electronic markets. One component that caught my attention was a Low Noise Amplifier IC from MACOM for the Personal Handy Phone, PBX and Personal Communications Systems and Network markets. The stated frequency range of the IC is 1700–2000 Mhz, it has nearly 50 ohm input and output impedances, draws 20 ma from a single 5-volt supply, a gain of approximately 20 dB, and a noise figure (NF) of approximately 1.7 dB. All this for about $8.00 each in small quantities. Just what I was looking for! With two ICs I was able to attain 39 dB measured gain. The calculated NF is 1.706 dB. (I was not able to measure the NF, since no test equipment was available to measure this parameter. As a note, the NF of ready-made LNAs for this frequency do have a lower NF, but with a 5-foot dish I figured these ICs would work fine.)

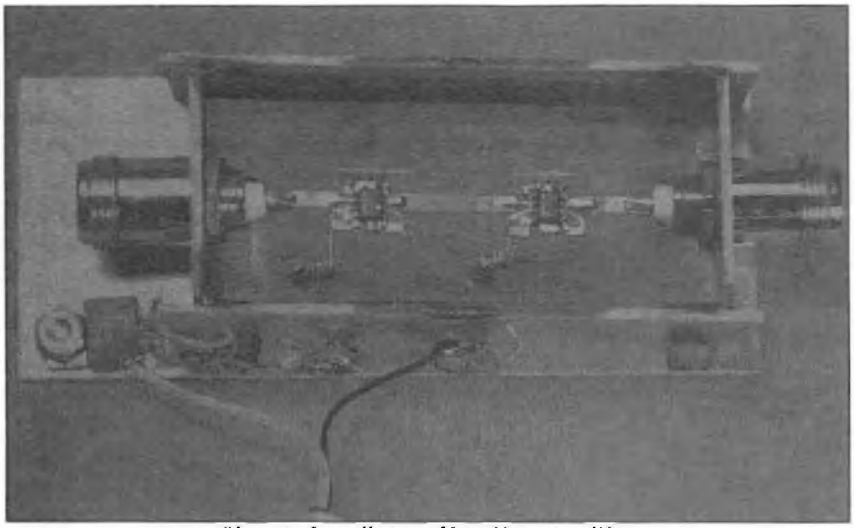


Photo A. Overall view of Low Noise Amplifier.

Technical

As shown in the schematic, the circuit uses two ICs and a few passive components. (See Figure 1.) The circuit comes from the manufacturer's data sheet. There are no matching networks and no bias supply. The ICs are surface mount packages, so be forewarned, they are very small. There are two versions of the IC: a lower-cost/higher-NF/higher-gain unit (the MAAM12031) and a (slightly) higher-cost/lower-NF/lower-gain unit (the MAAM12032). The 12031 has a 1.8 dB NF with 22 dB gain, the 12032 a 1.67 dB NF with 15 dB gain. The IC with the lowest NF is the first stage, followed by the higher-gain IC. (The first stage of a receiver should always be the lowest noise—it sets the sensitivity of the whole system.)

The 35-ohm resistor from pin 2 to ground is optional—it increases the gain by 2-3 dB and reduces the NF slightly, but also increases current draw from 8 ma to 20 ma per IC. Since we need more gain and a lower NF a lot more than we need low power consumption, we will use this resistor. In some handheld products (phones and such) you need as little current draw as possible from the small batteries used, so in these cases the IC would not use this resistor.

The track from the connectors to the ICs, and between the ICs, forms a 50-ohm transmission line. The thickness of the dielectric of the PC board, the type of dielectric (Teflon), and the width of the track (.100 inch) determine the impedance of the track. We need this to be 50 ohms so the IC sees the proper impedance. (In this case we *don't* want to do any impedance transformations!)

The materials needed are somewhat special but can be found at most larger hamfests. (See the parts list.) The chip capacitors, feedthrough capacitors, and chip resistors are also available from the source shown in the parts list. The capacitor should be an MLC type (Multiple Layer Chip). The PC board is 0.032-inch thick Teflon double-sided. It isn't cheap. I paid $9 for a 4-inch by 6-inch piece. Don't substitute any other type—only Teflon will work with the dimensions given.

I made the PC board using the plastic film from Meadowlake Corporation. It is very easy to use, but you will need access to a

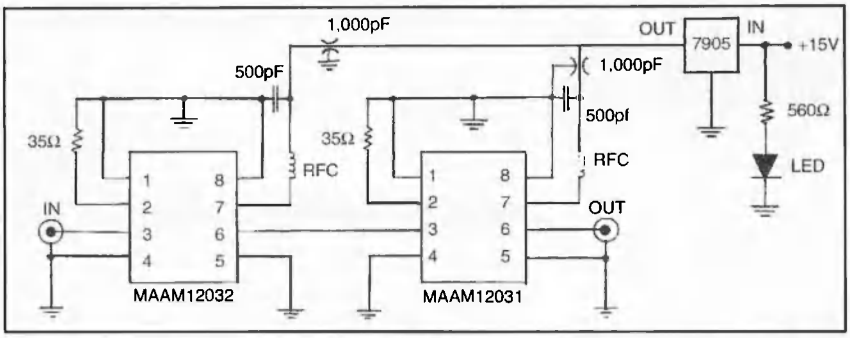


Figure 1.

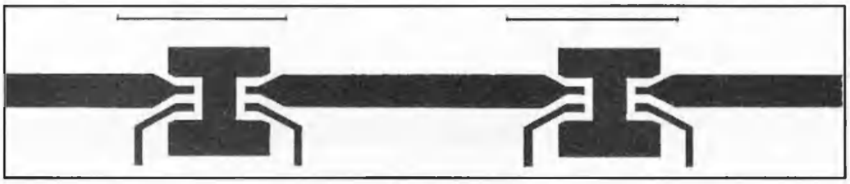


Figure 2.

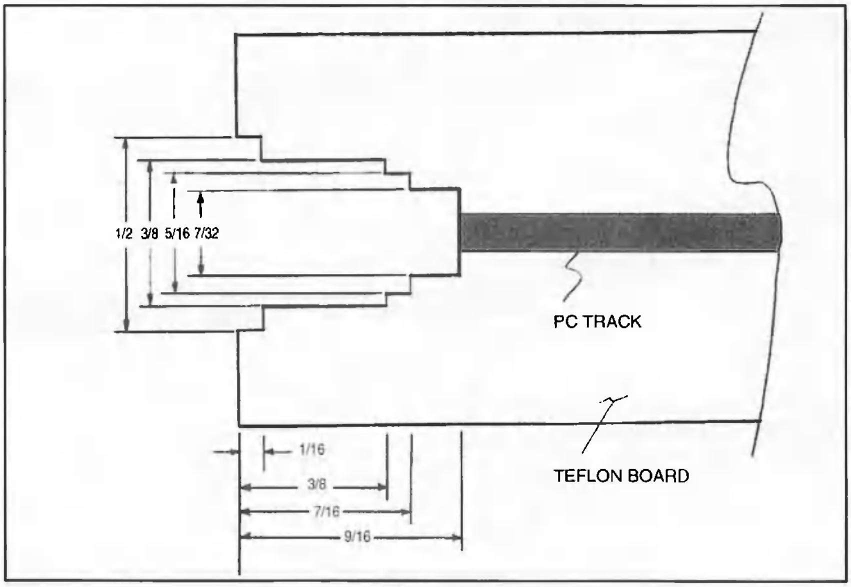


Figure 3.

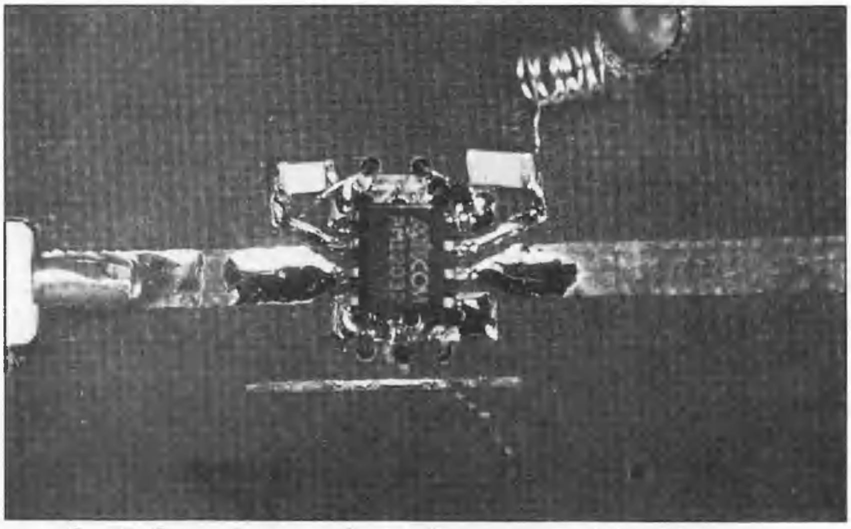


Photo B. Closeup of one stage showing all components, including "N" connector.

copying machine that has a variable reduction ratio.

The source of the ICs said they will lower their $50 minimum to $30 for these ICs. You should order two of each, just in case you damage one. If you can double-up an order with a friend, so much the better. Also, request a data sheet for each IC, or I can supply copies if you send a SASE.

The original artwork was drawn using PC Paintbrush that comes with the basic Windows software package for IBM PCs.

Construction

Start with the printed circuit board fabrication. (A printed circuit board, on Teflon, for this circuit is available for $9.50 plus $1.50 S&H per order from FAR Circuits, 18N640 Field Court, Dundee, IL 60118.) First copy/reduce the PC artwork from Figure 2. The small, thin, unattached line beside each IC pattern is used to ensure that you have used the proper reduction ratio. Continue reducing the image until this line is exactly 0.500-inch long. The remaining artwork will be the proper size. Next, the actual full-size artwork is transferred to the TEC-200 film using a copying machine. I filled the plastic sheet with as many copies as would fit on an 8.5 x 11-inch piece, so I didn't waste any of the TEC-200 film. Cut out one of the patterns and, using an iron, transfer the black pattern to a practice piece of PC board (don't use the Teflon board yet—remember how much you paid for it?). If you use the correct heat setting, time, and pressure, the traces will all have adhered to the copper with no broadening. Follow the instructions that come with the TEC-200 film. If you botched it, remove the black traces with MEK (Methyl Ethylene Ketone), cut out another pattern and try again. When you feel confident with your newfound skill, transfer a pattern to the Teflon board (first lightly clean the board with scouring powder and water). If you're happy with the quality of the pattern (no distortion or broadening of the traces) you're ready to put some resist on the ground plane side of the board. For this I used some Scotch +33 electrical tape, making sure the tape sticks to every part of the outside edge. You don't want to etch any of the bottom ground plane. Now we are ready to begin etching the board. Use a shallow plastic dish of copper etchant. The complete etching will take 15 to 20 minutes if you heat up the liquid with a spot lamp and gently tilt the dish back and forth. After etching is complete, wash the board with soap and water to remove all the etchant.

Then use a pencil to draw the pattern of the cutout for the N connectors at each end. (See Figure 3.) Use a fine square file to remove material in the cutout area. Secure the board in a vise and work slowly. Be sure to closely follow the profile of the connector and nut that you have drawn on the board.

Next, drill the four small holes near the ends of the ICs from the ground plane to the circuit side. (See Figure 4.) These are a poor man's plated through hole. Pass a small wire

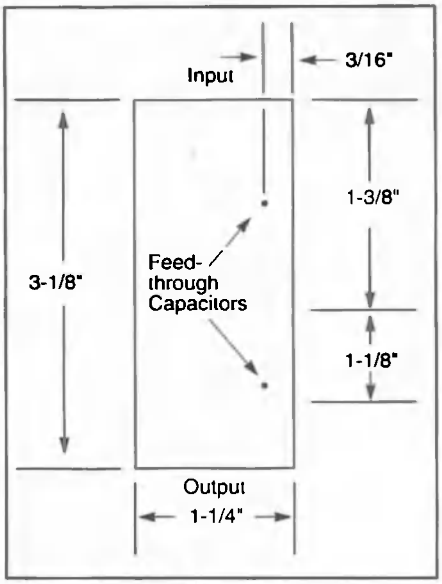


Figure 4.

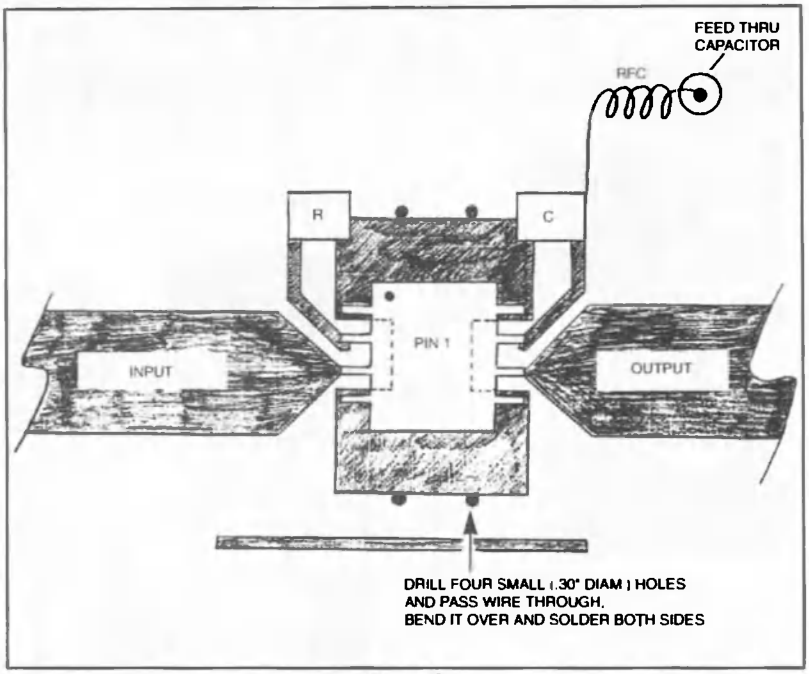


Figure 5.

through each hole, bend it toward the edge of the board on both sides, and solder. Next, drill the holes for the feedthrough capacitors. (See Figure 5.)

Make the end pieces for the N connectors out of 0.062 inch thick double-sided glass epoxy PC board. First drill the holes, then cut the end pieces to size. The hole is much easier to drill in a large piece of material. Check the sizes of the end pieces to make sure they are the same; if not, the box will be distorted and have cracks along where the panels fit together. Place the connectors in the holes and tighten the nuts. Solder the end pieces to the ground plane of the Teflon board, making sure the end pieces are square with each other and the Teflon board. (See Figure 7.) Solder the center conductor last, so you don't pull the track off the Teflon board. Next, mount and solder the resistors, capacitors and RF chokes as shown in Figure 6.

The next step is to solder the ICs in place, and TAKE . . . YOUR . . . TIME! There is a small dimple next to pin 1 on top the IC to show you how to orient the IC on your board. Use a small, fine-tipped, low-power soldering iron and small diameter solder. After soldering each pin, use a magnifying glass to check around the pins for any solder bridges. Squirt some isopropyl alcohol and brush lightly with an old toothbrush to remove any flux left on the board.

Cut both side panels and drill one small hole in one of the panels for the power lead to pass through. Next, clean all remaining panels around the edges in preparation for soldering. Solder all panels together, except the top and the side panel with the hole in it. Soldering the panels should be done with a large iron (100 watts). The side panel with the hole in it is next. Pull the wire through the hole, and then solder the panel in place. Squirt some more isopropyl alcohol inside and wash all solder joints to remove the flux. Mark the outside of the LNA with "IN" and "OUT" so you know which connector is which. Lastly, attach the top panel. Mount the 7905 voltage regulator and connect

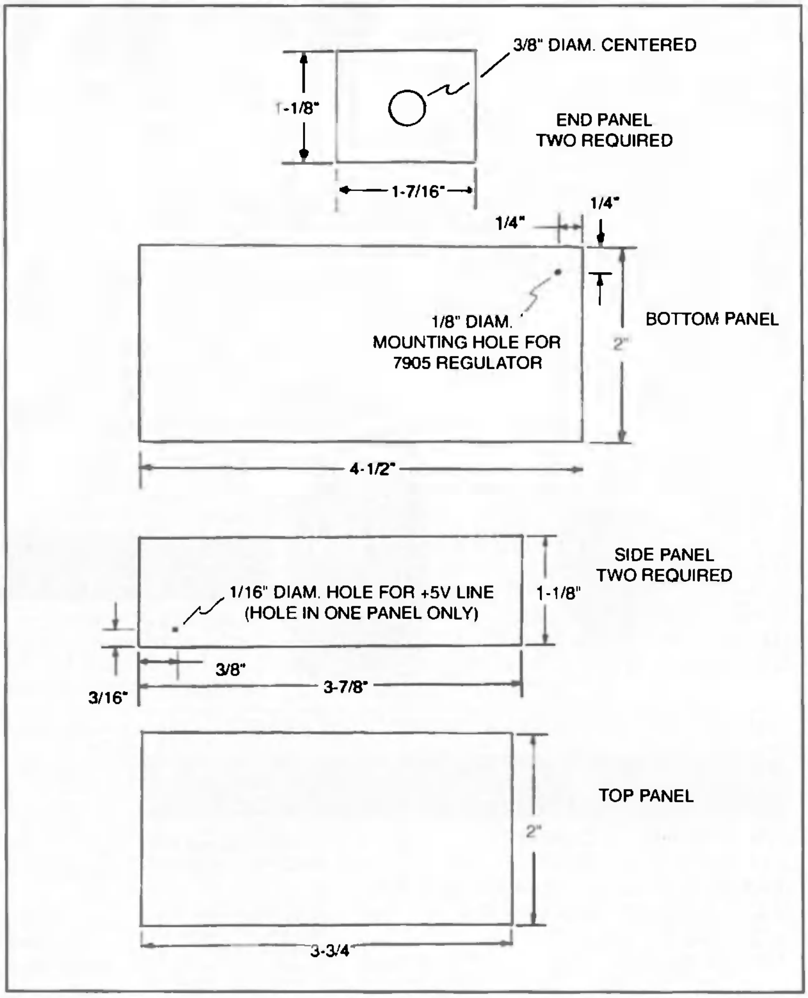


Figure 6.

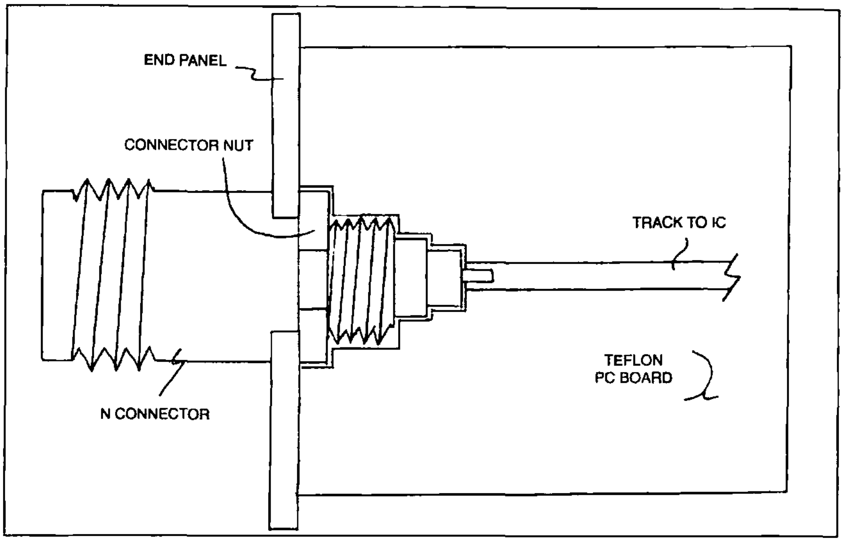


Figure 7.

the wire coming from the board to the output lead of the 7905. The center pin (ground) of the 7905 should be soldered to the side panel. Wire in the optional LED and its resistor if you want an indicator for power to the LNA.

Checkout

Apply +12 to +15 VDC to the regulator. Current draw at the input to the regulator should be 60 ma, +/-10%. If it isn't, you have some type of wiring error. Examine all the connections and check for solder bridges or other problems. Once your unit is drawing rated current, connect the output to a spectrum analyzer if one is available. The analyzer will tell you if your LNA is oscillating (bad) or not (good). If there is an oscillation, check all soldered connections for good, clean junctions. Remember: This unit has tons of gain—one loose bypass capacitor, etc., and it can oscillate. If all is OK so far and you have access to a weak signal source, apply a very weak signal (several microvolts) at or near 1691 MHz to the input, and monitor the output level. Measure the gain of the LNA; it should be near 40 dB. If you don't have access to a weak signal source, connect the LNA between your antenna and downconverter and check for a signal from the satellite. There are no adjustments to make, so if you constructed the unit properly, you should hear the characteristic 2400 Hz audio tone from GOES 8 on 1691 MHz.

You should place this LNA as close to your antenna as possible. I have mine attached directly to the feedhorn of my 5-foot home-brew dish. If the antenna is located outdoors, it will need to be weatherproofed. I have my dish located inside our garage, so I didn't have to weatherproof my LNA.

How does the LNA work? Very well! Using the LNA with my dish, a downconverter and police scanner produced a full-quieting signal from GOES 8.

I would like to thank Roger WA9OKC for his help in measuring the gain of the LNA, and Tim Ciesielski for taking the photos.

Parts List

1	Teflon board—0.032 inch double-clad *
1	Glass epoxy board—0.062 inch double-clad
2	Male type N Connector—3/8-inch hole mount *
2	Chip capacitor—500 pF Multiple Layer type *
2	Chip resistor—35 ohm ceramic
2	RFC (coil)—5 turns #24, 0.100 inch diameter, 0.125-inch long
2	Feedthrough capacitors—1000 pF *
1	TEC-200 printed circuit film **
1	PC etchant—Radio Shack P/N 276-1535
1	5 volt regulator IC—LM-7905 tab mount
1	560 ohm, 1/4 watt resistor—optional
1	LED—optional
2	MACOM part number MAAM12031 (one for LNA and a spare) ***
2	MACOM part number MAAM12032 (one for LNA and a spare) ***

*available from:
Microwave Components
P.O. Box 1697
Taylor, Michigan 48180
313-753-4581

**available from:
Meadowlake Corporation
Dept. A, P.O. Box 1555
Oneco, Fl. 34264

***available from:
Richardson Electronics
800-238-7661 (approx. $50.00 min. order)
(also Penstock 800-736-7862 has them but they have a $100 min. order that "may" be lifted soon.)

Number 6 on your Feedback card

Sailing with Ham and Marine Radio Equipment

Carry ham and marine systems aboard without permanent installation

by Gordon West WB6NOA

At last, summertime, and some great times out on the water aboard a boat. But you're not going to leave your ham radio behind, are you?

Sailing and boating with amateur radio is a terrific way to stay in contact with folks ashore, fellow boaters where you may be cruising, and backup communications to your regular marine radio in case of an emergency. Your communications may consist of 2 meter/440 MHz operation, and you very well might want to bring along your high frequency set, too. This article will point out how easy it is to put both of these systems aboard a boat without making a permanent installation of the entire setup. In other words, we are not talking about a permanently installed system where you are boring holes or laying hundreds of square feet of copper foil down in the bilge. Rather, you step aboard and, in a few minutes, you are on the air over VHF as well as high frequency.

> ***"You are probably wondering if there is a way to convert a marine VHF set over to ham radio 2 meter. Nope."***

VHF

A 2 meter set works great over the water to distant repeaters. The 2 meter band from 144 MHz to 148 MHz is relatively close to the marine VHF band at 156 MHz. This leads to some exciting possibilities with a sailboat that has a masthead marine VHF antenna hooked up to a 25-watt marine VHF set down at the navigation station. The marine VHF antenna works quite nicely at 146 MHz with only a slight rise in SWR. The tremendous boost in range because of the antenna height will be well worth the slight mismatch when transmitting into the antenna 10 MHz away from its naturally resonant frequency.

Don't disturb the installed marine VHF setup until after you get to where you're going. You might be the only one hearing a Mayday call on marine VHF Channel 16. If you want to play 2 meter ham radio on the way over to that distant anchorage or island, use the antenna that comes with your set, and leave the marine VHF system alone. Wait until you get to that distant cove and drop the anchor before you start playing ham radio with a marine VHF installation.

Many mariners tie the marine VHF antenna into their 2 meter hand-held transceivers. To do this, you will need an adapter that converts the marine PL-259 antenna plug over to a BNC connector. These adapters are available at all Radio Shack stores, and consist of a single piece with SO-239 threads that connects to a BNC that goes to your 2 meter hand-held antenna jack. Remove your rubber duckie, slip on the adapter, and then unscrew the coax cable that goes to the marine VHF transceiver onboard.

WARNING: *Use the marine VHF antenna only when the marine VHF transceiver is specifically turned off and not being used for marine radio calls and distress channel monitoring!*

If the cable coming down from the masthead antenna is rigid RG-8U, be careful not to flex the adapter on your hand-held 2 meter transceiver. Too much flexing on your hand-held antenna jack from heavy coax cable could ultimately break loose the hard-wire connection from the tip of the BNC jack to the PA transistor point on the internal circuit board. If that connection gets broken, it's a delicate fix! Be gentle with your hand-held antenna connection with coax going to it.

When you are hooked up to your sailboat marine VHF antenna, or to a 6-foot, or 9-foot, or 23-foot power boat white Fiberglas marine VHF antenna, 2 meter reception will boom in. Enjoy! Your little handheld on a 9-dB-gain power boat VHF antenna will sound like a 40-watt output (8X) improvement as compared to a little hand-held telescopic whip. The big marine antenna to a rubber duckie is like night and day—even though the marine antenna is not absolutely resonant down at 146 MHz, you will still have one heck of a signal on both transmit and receive from the multiple elements inside the Fiberglas whip. And to a masthead sailboat antenna, the height of that half-wave antenna will give you terrific results on 2 meters.

CAUTION: *Don't transmit on the 440*

Photo A. The Icom IC-M710 is in the marine SSB mode, set to distress frequency 2182 kHz.

Photo B. Now the IC-M7100 is a ham set, tuned to a 40 meter net on lower sideband.

MHz 70 cm band! Marine VHF antennas don't work on the amateur radio 440 MHz band, and attempting to try to get them to work could lead to an almost direct short on your power output jack. Many marine VHF antennas are DC, shunt-fed, half-wave in design, and except at a broad resonant point near 140 MHz to 160 MHz, the antenna looks like a DC short to other frequencies. Take my word for it, there is no way to get a marine VHF antenna to transmit on the 222 MHz or the 440 MHz bands.

If this is your own boat, and you are an active dual-bander on 2 meters and 440, you may ultimately wish to replace your marine VHF antenna with a ham radio 144/440 MHz dual-band antenna, and enjoy great results on both ham and marine VHF.

Modifying Sets

You are probably wondering if there is a way to convert a marine VHF set over to ham radio 2 meter. Nope. Marine VHF transceivers are preset for 25-kHz steps that correspond with the 55 marine transmit channels, and there is no way to take this type of PLL 25-kHz logic and swing it over to the amateur radio 2 meter band. Marine VHF also has a tight front end, and reception 10 MHz off of 156 MHz marine reception would be next to zip. There is absolutely no way to convert a marine 25-watt VHF radio or a marine VHF handheld over to 2 meter capabilities.

Yes, there is a way of modifying most 2 meter handhelds and some 2 meter VHF sets for emergency transmit on marine VHF. But you may not legally transmit on marine VHF with a 2 meter handheld, because your 2 meter handheld does not possess the necessary FCC Part 80 type-acceptance spelled out in Marine Rule 80.43: ". . . Transmitters . . . must be type-accepted for a particular use by the Commission based on technical requirements . . ." However, in an emergency, marine Rule 80.311 allows any type of transceiver to be used in a distress: ". . .Station in distress may use any means at its disposal to attract attention . . ." This means a modified 2 meter ham radio transceiver is perfectly allowed to come up on marine VHF Channel 16, 156.800 simplex, to holler "Mayday!" in a life-and-death situation.

By the way, using your ham radio set aboard a cruise ship requires permission of the master of the ship before transmitting. Same thing for private vessels—be sure to get the skipper's permission before you start transmitting over the airwaves.

High Frequency SSB

The high frequency marine radio system offers ship-to-ship and ship-to-shore frequencies for the non-ham mariner on the following bands:

2 MHz	12 MHz
4 MHz	16 MHz
6 MHz	22 MHz
8 MHz	26 MHz

"The ship station license does not require a test, other than the mental anguish in poring over FCC Form 506 and getting down all the information the FCC requires."

Mariners cruising beyond normal VHF marine radio line-of-sight range to the Coast Guard and other stations are encouraged to equip themselves with marine SSB. FCC Form 506 allows ship station call letters to cover not only the marine VHF onboard, but also long-range marine SSB equipment, in addition to radar and emergency-position-indicating radio beacons. The ship station license does not require a test, other than the mental anguish in poring over FCC Form 506 and getting down all the information the FCC requires. For marine single sideband, you must also hold a restricted operator's permit, valid for life. This is the brown card that you might have been carrying in your wallet from the old days of operating business radio, taxi radio, police radio, or aircraft and marine radio. The restricted operator's permit does not expire, and you obtain it by filling out FCC Form 753. *To receive a free copy of FCC Form 506 and 753, send a large self-addressed envelope with six first-class stamps on the inside to Gordon West Radio School, FCC Forms, 2414 College Drive, Costa Mesa, CA 92626.*

Marine single sideband is channelized, by international agreement, with specific channels for duplex operation to marine telephone stations ashore, simplex channels for ship-to-ship, and duplex channels for ship-to-Coast Guard. (For a list of marine ITU simplex and duplex SSB high frequency channels, four first-class stamps and a self-addressed envelope to Gordo will get you the latest list.)

Marine SSB emissions are single sideband, identical to ham radio HF emissions. However, all marine frequencies are upper sideband, whereas high frequency ham is either upper sideband or lower sideband.

Marine SSB transceivers must be FCC Part 80 type-accepted. The main reason for type-acceptance of marine SSB is to insure spectral purity, with in-hertz frequency stability, minimum harmonics, and user lockouts to prevent a marine SSB transceiver being dialed into unauthorized frequencies.

Double-use Sets?

Interestingly, that last item, "user lockout," has taken a new meaning when manufacturers developed their latest breed of marine SSB transceivers. SGC, Inc. (Bellevue, WA), indicated that the marine SSB Model SGC-2000 is rated for both Part 80 marine radio use and ham radio use. And since amateur transceivers don't require type-acceptance, using a marine SSB with an agile synthesizer on amateur radio high frequency ham bands is indeed technically feasible, with a signal that is just as clean as any modern ham radio set. Model SGC-2000 requires no additional modification or "diodectomies" to work straight out of the box on ham HF SSB. Same thing with the Icom M-700 and Icom's latest dual-purpose marine/ham transceiver, the sleek IC-M710.

Almost all other marine SSB transceivers are easily dialed into the amateur HF bands with some simple keystrokes to unlock the transceiver, or the snip of a diode here and

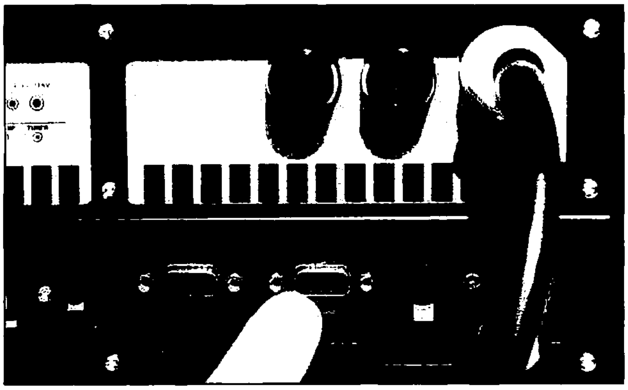


Photo C. The rear of the Icom marine transceiver offers output jacks for weather fax, data, and the APRS positioning service.

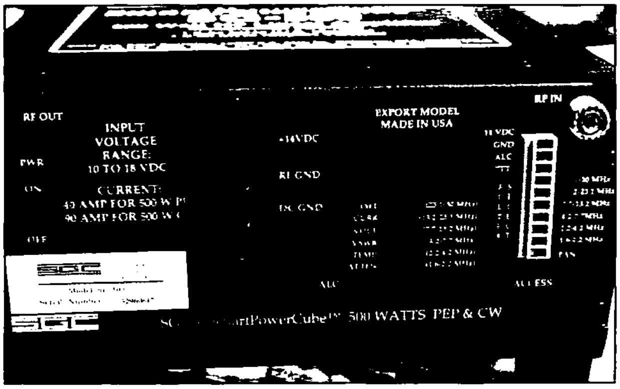


Photo D. The Icom marine SSB (on the bottom) is tuned to a marine duplex channel.

there. But once you cut a diode, you have now nullified the type-acceptance of that marine transceiver for Part 80 marine use.

If you have modified that marine transceiver permanently over to ham radio use, no problem. Keep in mind that FCC Part 80 rule that lets you holler "Help!" into any type of set in an emergency.

But what about Model SGC-2000 and the new Icom IC-M710, where no modification is necessary to access the ham bands? Is this legal? Opinions vary within the Federal Communications Commission.

George Dillon of the FCC Marine & Aviation Branch points out amateur radio Rule 97.11 for radio equipment aboard ships: "... The station must be separate from and independent of all other radio apparatus installed on the ship . . . except a common antenna may be shared with a voluntary ship radio installation . . ." Dillon points out this rule is an old one aimed at "sparky," the commercial radio operator, to prevent his playing ham radio down on 160 meters when he should have been listening to 500 kHz CW traffic.

FCC's Jerry Freeman W4JJ, an avid ham and boater, raises the question about a voluntary marine SSB installation and how that station is to be used by the licensed amateur operator. Could the ham go down to the boat on a Monday and consider that marine SSB transceiver as a marine radio for making a ship-to-shore phone call, and then go down to the boat on Tuesday and put on the ham hat and consider this apparatus as perfectly legal on the ham bands? After all, hams can use *any* type of radio equipment on ham bands as long as it meets with good engineering practice and clean spectral output. Jerry Freeman would point out that a separate ham set and a separate marine transceiver would definitely meet the letter of the law, but how a licensed ham would view an SSB transceiver would be an interesting question to ponder. And since voluntarily equipped vessels are not required by law to have a specific listening watch on marine SSB, or required by law to have a marine SSB onboard, who's to say that the new SGC or Icom marine transceiver is really an SSB marine radio rather than an agile ham rig with Part 80 emergency capabilities?

How about the popular practice of modifying a ham set for marine ship-to-ship and ship-to-shore communications? ***Absolutely illegal***, comment both Freeman and Dillon of the FCC. Ham sets are not Part 80 type-accepted for marine radio use and, except in an emergency, cannot be used on marine radio frequencies.

Emergency Use

Any rule that prohibits a ham from making the necessary modification to the HF ham set for emergency marine transmit? None on the books—and many mariners will dive into their ham radio HF transceivers, perform the modification, store simplex ship-to-ship and duplex ship-to-shore channels, and have them available for a true emergency call.

Wouldn't you rather communicate directly with the Coast Guard when you're pulling people out of the water from a nearby emergency rescue than calling Mayday on 14.313 MHz and ending up in the middle of a jam session? I certainly would feel more at ease out on the high seas knowing that the United States Coast Guard Rescue Coordination Center is just a call away over marine SSB channels than hollering for help and ending up with someone telling me to QSY because they're working rare DX down the bottom of this band.

What I recommend is to analyze how you plan to use your HF SSB capabilities out on the water. If you're going to be using mostly marine channels and marine ship-to-shore frequencies, go with the marine SSB transceiver, but choose the SGC or Icom sets that require no modification for ham radio use when you are no longer using this same radio as a marine SSB set.

"Wouldn't you rather communicate directly with the Coast Guard when you're pulling people out of the water from a nearby emergency rescue than calling Mayday on 14.313 MHz and ending up in the middle of a jam session?"

However, if you are an avid ham, and only need the *backup* of marine SSB distress channels in an emergency, then run the ham set aboard, but have it ready for emergency transmit capabilities with marine channels stored in ham memory slots. The best ham sets for this purpose would be any Kenwood, Yaesu, Icom, and Alinco HF transceivers offering 100 simplex or duplex memory slots. The modified ham set for emergency capabilities should also be netted with WWV using upper sideband for spot-on center channel, because most ham sets are set a couple of hundred hertz low (hertz, folks, not kilohertz) to compensate for the ultimate slight drift of the PLL reference crystal. On ham frequencies, 200 hertz is nothing—but it will quickly earn an FCC pink slip on marine band. And using a ham radio for routine marine channel communications will earn a major FCC pink slip if you should get caught.

Having a marine license aboard, a personal marine restricted operator's permit, and a General Class ham license, and then using a Icom or SGC marine set on ham radio—I couldn't find an FCC engineer who has ever written anyone up for a legitimate operation of this type.

The Antenna Setup

The marine and ham SSB transceiver usually feeds to a fully automatic microprocessor antenna coupler. On sailboats, the coupler goes back aft in the lazarette and feeds a single-wire output (called GTO-15 high voltage wire) to an insulated backstay or to a 23-foot nonresonant aerial. On power boats, the microprocessor automatic antenna coupler feeds a 23-foot white Fiberglas aerial, and both systems use copper foil down to bonded underwater through-hulls for a good ground plane "push off." Copper foil is used to minimize the inductive reactance found in round ground wires. Just a couple of interconnections to the water is all that's necessary for an adequate ground plane using the modern microprocessor-based tuner. For temporary installations, many mariners chose the Outbacker "OBM" ham/marine resonant whip with specific band taps for each ham band and each marine band. Simply plug the "fly lead" into the appropriate band—say 20 meters for ham, or 8 MHz for marine—and the whip operates as a 1/4-wavelength, pretuned, helical-wound resonator with a tunable tip to adjust SWR to a minimum.

The Outbacker "OBM" for the ham-only/marine-only whip *must* be mounted over a horizontal stainless steel rail in order to work. The horizontal rail acts as the ground plane for the 1/4-wavelength whip. No metal rail, no worky. The whip cannot work off of Fiberglas, nor will it work mounted to a teak or composite deck. The whip does not mount at the top of the sailboat mast, nor does it mount with a ball mount on the side of the hull. It must be mounted with its included stainless steel bracket directly over a horizontal metal rail with at least three feet of rail on one side or both sides of the whip. The tail should also be counterpoised to a sea water or fresh water ground via metal through-hulls in the boat.

Performance on the Outbacker? Eighty percent of what you would get with an automatic tuner into a 40-foot backstay. (A mounting installation booklet and technical reference sheet on the marine Outbacker antenna are available free with a self-addressed envelope and 6 stamps to Outbacker, 330 Cedar Glen Circle, Chattanooga, Tennessee 37412; Att: Don Arnold WD4FSY.)

Fun and Safety

Maritime mobile can be a lot more fun this summer when you bring your ham radio equipment onboard. You don't need to bore holes, nor lay hundreds of feet of copper foil to achieve long-range results. And in an emergency, you could use your ham set on marine frequencies, too.

And while you are out cruising, be sure to switch your installation back over to your marine setup, and guard the distress channels for others around you who may need a radio lifeline for help.

73 Review

Number 7 on your Feedback card

Don Johnson K7UGQ

Radio Shack
1500 One Tandy Center
Ft. Worth TX 76102
(800) 843-7422
Price: $349.99

First Look at the Radio Shack HTX-212, 2 Meter Mobile Transceiver

It looks like any other two meter mobile, but this product is unique.

Over the past couple of years Radio Shack has established itself as a supplier of moderately priced communication radios. in the handheld department, the HTX-202 and HTX-404 handhelds have been a popular selling item for the boys from Ft. Worth. Sooner or later, you almost knew Radio Shack would offer a legitimate two meter mobile radio. Since I own an HTX-202, I was curious as to what I might find with this new mobile and how it compared with other 2 meter mobile radios I own.

The HTX-212 looks like any other two meter mobile. The multipurpose buttons, front panel display, and a very small case make the HTX-212 a nice-appearing radio, resembling most 2 meter rigs on the market today. In fact, there's a strong resemblance to the Kenwood line of two meter transceivers, yet after a lengthy discussion with Radio Shack personnel, I am confident that the HTX-212 is uniquely a Radio Shack product. In addition to the transceiver itself, the manual, a single-fused power cable, the DTMF microphone, and a mobile mounting bracket are neatly packaged within the small shipping box. The mobile bracket can be mounted either on the top or the bottom of the radio. Large thumb screws with rubber washers and a microphone attach-clip complete the mobile attachment.

Features

The HTX-212 offers selectable power output (10 or 45 W), built-in DTMF encoder and decoder, dual VFOs, 31 memories, multiple scanning schemes, and extended receive frequencies. Couple these and other features with probably the best sounding transmit audio of any transceiver on the market today and you have the Radio Shack HTX-212.

The receiver is a dual conversion type, with a first IF of 21.4 MHz and a second IF of 455 kHz. With 0.25-microvolt sensitivity, not too many calls will go unheard.

The front panel layout is fairly standard; however, some features requiring the use of multifunction buttons can be confusing, if not dangerous. This holds true especially if you try to access them while driving. Several buttons are not intuitive, so keep the plastic cue card close by. The manual does not address all the functional indicators in the display, but, fortunately, most operators can figure out most indicators without any explanation. When powering up, all annunciators in the display light up and a three-tone announcement signifies "all's well."

Panel brightness is adjustable as bright/dim. However, during daylight you'll find no difference, and in the dark the difference between bright and dim is functionally insignificant.

CTCSS encoding and decoding are both supplied as standard features. Unlike some radios which limit the number of stored digits to 6 or so, the HTX-212 allows up to 16 digits per CTCSS memory, enabling the operator to store access codes and commonly called phone numbers, a safety feature while driving.

The HTX-212 did not get hot during long periods of operation on high power, due to the extra large finned heat sink. Nor did the radio get hot or fail when it was run at full power without an antenna. The HTX-212 SWR protection circuits are designed to protect it while transmitting at full power without an antenna load, or with a dead short at the antenna connector.

There are two methods of selective tone paging, subaudible and standard DTMF tones. When chosen, either method will turn on the speaker and sound a three-tone alert. An "auto-reply" confirmation code can be automatically transmitted to the sending station, acknowledging receipt of the call. For those operators who need selective calling, the HTX-212 offers *group calling*. A large group (e.g., local RACES or search and rescue groups) can be individually assigned a special identification number. The whole group can be simultaneously sent a page, or any portion of the group can be earmarked for calling.

The HTX-212 has the scanning functions common to all two meter rigs on the market: band and memory scanning, selectable boundaries, lockouts of unwanted channels, call and priority channels, etc. All scanning commands must be initiated from the front panel, as Radio Shack does not offer scanning from the up-down buttons on the microphone. During my tests of the HTX-212, I found that reaching for the small memory scan button or accessing the timed two-button sequence for VFO scanning can be difficult, if not unsafe.

Manual

The 40-page manual is written to satisfy all classes of users. The novice will not be intimated by technical language while experienced users should not be insulted, either. Several diagrams illustrate the hows and whys of assembly and mobile mounting, very helpful if you've never had the opportunity to install a mobile rig. As with other Radio Shack equipment, I'm sure they will offer one of their excellent service manuals.

An X-ray view of the mike plug identifies all eight wires for use in connecting a packet TNC system. No mention is made of the type of plug or where you can get one, but Radio Shack's corporate offices assure me that the plug is used in computer networking and is carried as their part number 279-440.

Separate from the manual, a plastic cue card lists the more common and popular features. The card is well done and designed to fit in your car's sun visor. One of my other two meter mobile rigs came with a fold-up wallet cue card. After several months pressed in my wallet, the card was not usable.

Performance

Attempts to introduce cross modulation and intermodulation were fruitless. Although my testing was in a non-lab environment, I spent two weeks on the road through New York, Vermont, and Connecticut, during which I subjected the transceiver to actual everyday use, including leaving the rig in a rental car overnight in minus-13-degree cold, installing the rig in three different vehicles, and getting power

from both direct battery connect and cigarette lighter plugs. Results: no problems! I purposely pulled up behind city vehicles that were transmitting, drove through Hartford's infamous "intermod alley" and ran another two meter rig in the car. Never did I experience any unwanted interference. This exceptional selectivity feature of the HTX-212 is the result of the Radio Shack engineers' use of a "Tracking Bandpass Filter." TBFs are expensive and seldom seen in amateur radio equipment. The front end of the HTX-212 is as tight or tighter than the HTX-202 handheld. To the country boy, front end selectivity may not be very important, but anyone near the big city needs all the help they can get.

One of the first things noticed when I put the rig on the air was its excellent transmit and receive audio. At one time or another, someone will comment about the excellent quality of the transmit audio. While sitting in the mobile with the windows down, I've had no problem understanding stations through the built-in speaker.

Criticisms

Owning the HTX-212 has been a love-hate relationship. The good features I covered above.

What's missing? The ability to store out-of-band frequencies in memory. Since you cannot store the local weather frequencies or public safety stations, you have to ask why the expanded receive even exists. However, either one of the two VFOs can be used as scratch pad memory allowing storage of any two out-of-band frequencies. Of lesser import is the unlit keypad on the microphone. I say lesser only because backlit microphones are seldom visually clear enough to see in the dark, anyway. However, I know of no other major contender in the two meter mobile arena that does not have a backlit DTMF mike.

Although this is a mobile transceiver, I feel that Radio Shack engineers forgot the ergonomics of mobile operation. Using the DTMF memories while mobile can be a bit dangerous. As many as six key strokes must be made to set the correct DTMF channel, access the frequencies, and reset/return to normal operation. I programmed the access (UP) code for the autopatch of a local repeater in DTMF memory 1, my home phone number in memory 2, and the disconnect code in memory 3. In my neck of the woods, autopatch access codes are five characters or more. The multiple key strokes required on the HTX-212 should only be done while the automobile is at rest. Better yet, manually keying in an autopatch may actually be easier and faster!

The only performance flaw I found is in the squelch. Once set, the set point appeared to drift. Motorboating begins with the squelch eventually opening completely. I also observed that the squelch set point appears almost at the end of the squelch control travel, approximately 30 degrees from the end. Attempts to isolate the cause to something in the car was futile, indicating randomness. I noted this problem in all three rental cars and also the family car, usually after extended operation.

Value

When comparing suggested retail prices, the HTX-212 is positioned as much as 25% less than the suggested list price of the competition. However, street prices of other transceivers, coupled with sales promotions, (often called promos) could eliminate any pricing advantage. Regardless, one area that competition won't be able to approach is the extended warranty offered on the HTX-212. For less than $8.00 a year, five years of warranty can be purchased from Radio Shack dealers.

Wrap-up

The HTX-212 is a small two meter mobile transceiver that, like its sibling the HTX-202, may become the number one selling two meter mono-bander. The value of this rig does not lie in its features or any superficial gimmicks but in its robust design and high quality of manufacture. Setting the inconveniences aside, the HTX-212 is a solid rig, with performance equal to or better than what is available in the market today. 73

General	
Frequency range:	144.60—148.00 (Transmit) 136.00—174.00 (Receive)
Steps:	5/10/12.5/20/25/50/100 kHz
Memory channels:	1 calling frequency memory 30 standard frequency memories
Mode:	FM (F3)
Power Supply:	13.8 VDC ± 15%
Output/current drain:	Transmit—high (45 W) = 9A low (10 W) = 7 A Rec-stdby—0.1 mA
Dimensions:	42 x 142 x 160 mm
Receiver	
Type:	Dual conversion superheterodyne
Interm. Frequency:	1st: 21.4 MHz 2nd: 455 kHz
Sensitivity:	0.25 μV for 12 dB SINAD
Spurious response atten. and adjacent channel rej.:	Both better than 60 db
Audio output:	2.0 watts w/2% distortion max.
Hum/noise:	Greater than 40 db
Transmitter	
RF Output:	45 W (high)/10 W (low)
Spurious emission :	Better than 60 dB
Max. deviation:	5 kHz

Number 8 on your Feedback card

by Michael J. Geier KB1UM

Absolute Value Systems
115 Stedman Street
Chelmsford MA 01824-1823
Telephone: (508) 256-6907
Price Class: $239.95

Pasokon TV Slow-Scan TV Interface

SSTV for everyone!

Amateur slow-scan TV has been around for many, many years. The first experimenters used long-persistence phosphor displays "liberated" from old radar systems, and the quality was crude, to say the least. Still, it was a tremendous achievement to transmit pictures over our 3-kHz voice channels, and the SSTV art has slowly evolved ever since. The next wave used dedicated scan converters, which were digital memory boxes that could convert the normal TV scan rate down to something slow enough for narrowband transmission. The converters worked well, but they were quite expensive, and most were limited in their image processing capabilities beyond the basic functions of transmitting and receiving.

There are still plenty of the latter-generation dedicated scan converters on the air, and a few are still being made. These days, though, the trend is toward a more powerful, cheaper SSTV realization using that ubiquitous digital box we all love so much: the personal computer.

Wanna see what's being sent on 14.230 and 14.233? Wanna send some pictures of your own? All you need is an IBM-compatible computer and the new Pasokon TV system, which includes an interface board and the required software. I just recently got mine, and I'm having a great time with it.

Photo A. Screen shot of Pasokon's Mac/Windows-like interface.

What You Need

Although the system can be run on a 286, you're much better off with a 386 or higher processor. I tried using it on my old 286, and it worked on most modes, but came up with "machine too slow" when I tried to receive some Robot 12-second pictures, which come in pretty fast and actually demand more of the computer than the newer, slower modes.

You need a standard ISA bus; the thing won't work with a microchannel bus of the PS/2 type. The more memory you have, the better, but you can run the system on anything, even 640K! Extra memory, however, lets you store multiple pictures in RAM, which is extremely handy, for reasons I'll get into shortly. A mouse is very useful with the Pasokon system, but you don't need one. I don't have one and I'm able to use all the functions without it.

The quality of displayed pictures depends a great deal on your VGA card. The system works best on a 1-meg card with 32K color capability and VESA 1.2 conformance. I tried it with such a card, and the pictures were pretty stunning. You can, however, use it with a less capable card. My 1-meg card blew a RAM chip (through no fault of the Pasokon) and I switched back to my old 512K, 256-color card. At first, it looked terrible. After reading the manual, though, I ran the included universal VGA driver, and it allowed the Pasokon to use my card in a better graphics mode. The result was that pictures looked almost as good as with the 1-meg card, though not quite. No matter which card you use, the system still receives and saves pictures in the highest quality; if you later upgrade your card, you can see previously saved pictures in higher quality!

"The system works best on a 1-meg card with 32K color capability and VESA 1.2 conformance. I tried it with such a card, and the pictures were pretty stunning."

What You Get

The Pasokon TV system consists of an interface board, a 3.5" disk and a user manual. The interface board is basically a modem

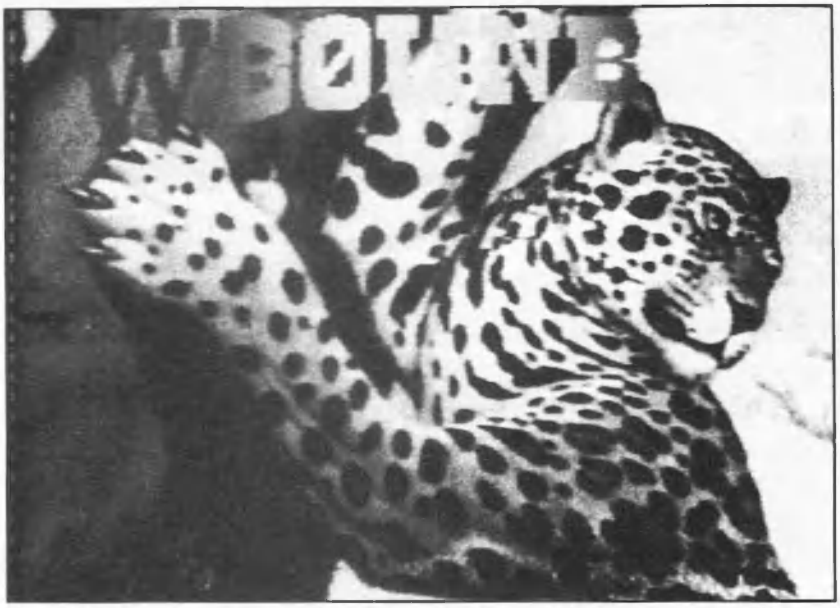


Photo B. With the press of a key, the interface vanishes, and the image grows to full-screen (320 x 240) size.

and a timing circuit which helps the computer decode the SSTV information. The computer itself does most of the work, which is as it should be. The system supports just about every SSTV mode ever created, including the AVT (Amiga Video Terminal) standard. Unlike other modes, AVT does not use horizontal sync pulses, requiring very precise timing on both the transmitting and receiving ends in order to avoid slanted or distorted pictures. There are some advantages to that approach, the biggest one being that fading, noise, or QRM cannot mess up the sync timing, because there isn't any sync in the first place! Pasokon TV supports the AVT mode the right way, using its own onboard, crystal-controlled timing oscillator, rather than trying to rely on the computer's timing, which can vary from machine to machine. To make sure the timing comes out exactly right, there's even a trimcap, accessible from the outside, so you can set it perfectly. You can do this several ways: by watching pictures as they come in, using an external receiver to calibrate the oscillator, or connecting a frequency counter. If you have one, that's the quickest, best method. The board comes pre-calibrated, so you may not have to do it at all.

"All you have to do is fire up your computer, set your rig on an SSTV frequency such as 14.230, press the on-screen 'receive' button and wait."

It is important to note that, like all currently available computer-based SSTV systems, the Pasokon does not include a video digitizer to get your own pictures into the computer for sending. Of course, you can still send computer-generated images and pictures you've received from other stations, but, if you want to send live "snaps" of yourself, your shack, your dog, or that latest homebrew gadget on your workbench, you'll have to find some way to input the pictures. Digitizers can be had for about $300, or perhaps you can use a friend's unit to get a bunch of pictures ready for transmission. Once you have them on a disk, you can put them into your computer and be ready to go.

Getting It Running

Basically, you just plug the board in, install the software and wire up the cables. Although common wiring schemes are shown in the manual, no pre-wired cables are available; there are just too many kinds ol rigs out there to make that possible. Cleverly, the Pasokon board includes a relay for audio routing, so that you can keep your mike connected. Or, if you're using your radio's accessory connector, you can keep your TNC, RTTY unit or other outboard gadget hooked up. When you operate SSTV, the Pasokon takes over and routes the audio to itself. When you go back to other modes, the relay switches out and the Pasokon effectively disappears. It's all pretty convenient. You will, however, have to make the cable, using the included interface connector and your own audio plugs, which you provide. But heck, we're hams! If we can't even wire up an audio connector, what are we doing in this hobby? For most of us, it should be no problem at all. I had mine up and running in about fifteen minutes, and it worked the first time.

If you have a standard PC, with standard addresses and interrupts, the Pasokon board should be all ready to go. Just plug it in and you're done. If, however, your machine has some conflict, perhaps due to other peripherals sharing the same address space or something, you'd better know something about PCs and their architecture. You can set the Pasokon for other addresses and interrupts, but the manual assumes you know what you're doing; it's not written for beginners.

By the way, you can't run this thing under Windows, Dosshell, or any other menu shell program, because the decoding of SSTV signals requires very precise timing with which the menu programs can interfere. So, you'll have to quit out of Windows and run it under DOS. Luckily, it's no big deal to do that.

How It Works

After the software loads, you're presented with a Mac/Windows-like screen, with various buttons for transmission, reception and mode. At the top are pull-down menus for numerous functions, including saving and loading pictures, selecting from the included noise-reduction and enhancement routines, and even running other programs (such as for a digitizer) without quitting the Pasokon environment. You can use the menus with a mouse or by pressing the ALT key.

Receiving Pictures

All you have to do is fire up your computer, set your rig on an SSTV frequency such as 14.230, press the on-screen "receive" button and wait. The Pasokon decodes the VIS (vertical interval signal) codes which tell SSTV systems in what mode the picture is sent. It's really nifty to watch it switch to, say, Martin 1 when the picture starts. If, though, you tune in after the picture begins, you can still select the mode manually, as long as you know what it is. That might also be necessary if noise or QRM obscures the VIS code. Most of the time, though, the automatic feature takes care of it quite well.

If you're using an analog rig, or the sending operator is a bit off frequency, you may need to fine tune your receiver. The Pasokon includes a real-time, on-screen tuning indicator that is actually an audio spectrum analyzer! It shows you the incoming audio on a little, vertical graph, with a red box at the bottom for the sync. To tune, you just center a line within the box, and you're done. It isn't very critical, though, because the software will lock to signals as much as 100 Hz off frequency. The line also serves another function: it indicates the software's degree of certainty that it is, indeed, receiving sync pulses. As the sync is received, the line gets longer. If fading or noise starts to obscure the sync, the line shrinks and eventually disappears.

As a picture comes in, it's displayed in real-time in a generous window next to the tuning indicator. After the image is complete, you can press a button and the user interface will go away and be replaced by a full-

screen image of the received picture in all its 320-pixel by 240-line glory. It looks great!

Well, usually. If QRM or other noise has damaged the picture, you may be able to clean it up a bit using some of the included image enhancement features, such as low-pass filtering or two kinds of noise reduction. Depending on the original state of the image, these features can really help, although they sometimes blur the picture more than you might want. That's no fault of the Pasokon software, though; it's an unavoidable price of some of these kinds of image manipulation.

If you have extra memory, here's where it comes in handy. Instead of saving the picture immediately, which might cause you to miss the next one coming in, you can just leave it in memory. A small box at the bottom of the screen will display it in postage-stamp size. Depending on how much extra memory you have, you can get up to ten simultaneous pictures across the bottom of the screen. My 2-meg machine gives me four of them. I just save 'em up until there's a lull on the frequency, and then I store them to disk at my convenience.

Two extra-cool features in the Pasokon are its sync squelch and auto-save, which let you walk away and snag pictures automatically. The sync squelch makes sure voices or noise don't get misinterpreted as picture data, and the auto-save dumps received pictures to disk, using a numbered naming scheme. So, you can start it all up, go away for awhile, and come back to a whole bunch of images already stored on your hard drive.

> ***"The Pasokon is the most fun I've had on amateur radio in a long time. I highly recommend it."***

Transmitting Pictures

As I mentioned before, there's no included digitizer. There is, however, a provision to take 3-D pictures! The procedure requires you to take two snaps with your digitizer, one for the left and one for the right view. The software then alters the colors of the two views and combines them so that the resulting picture looks 3-D when viewed with red/blue glasses, which are included. And yes, you can send that image and it will still look 3-D at the other end, as long as the receiving operator also has the glasses.

To send a picture, you just get it into memory, either by digitizing some video, loading a stored image from disk or simply receiving a picture off the air, and then select the desired transmission mode and press Xmit. Away it goes! You don't have to convert the image in any way to use it in various modes. Even if you received it in Scottie 1, you can send it in AVT if you feel like it.

There's an externally accessible trimpot on the board which lets you adjust the audio output level, so you can set it up for the desired output power level from your radio. Many radios can't send SSTV or other full-duty-cycle modes at full power, requiring you to reduce it to half or less. I set mine up so it would put out 50 watts with the mike level control set to its normal voice position.

What I Liked

The Pasokon does exactly what it's supposed to, and it does it well. It supports various graphics standards, including GIF, TGA and PCX, so you can easily upload your received pictures onto online computer networks. And, converting a TGA file into GIF is as simple as loading it and resaving it in the new format. The software is easy to use, and the hardware installation is fairly hassle-free, as long as your computer doesn't have any special requirements. The cost of the system is very reasonable for what it does.

What I Didn't Like

There isn't much to complain about on this thing, but there are a few minor points. When you save a picture, the screen doesn't show its filename above the image until you reload it. That makes it hard to know which received pictures you've already saved. It would be better if the filename appeared as soon as the save was complete.

Although the image enhancement features work decently, there's no provision to replace "hits," or noise-destroyed lines of video, with the previous line. That technique is standard in VCRs and is present in various computer image systems, and I wish it were available here. Of course, you could load the image into other software to fix it, but it would be a lot more convenient if the capability were included.

The pull-down menus are handy, but, when used without a mouse, they don't allow you to scroll down the options to pick the one you want. Rather, you must select the desired function by its letter. If you try to scroll down the menu, it just rolls up and disappears.

The manual, while fairly complete, is not written for the computer neophyte. Some of the explanations could be more complete, particularly regarding addresses and interrupts, a subject which confuses many people.

> ***"If you've ever wanted to get into SSTV, this is a great way to do it!"***

Conclusion

If you've ever wanted to get into SSTV, this is a great way to do it! I hope digitizer hardware comes down in price enough that computer-based systems can include it. Even if you have to buy a separate one, though, the price of a complete computer-based SSTV system is far lower than that of a dedicated scan converter, and the utility is much greater. The Pasokon is the most fun I've had on amateur radio in a long time. I highly recommend it.

Oh yeah, before I forget . . . A demo, receive-only version of the Pasokon system called EZSSTV is available on various computer networks, including the ARRL BBS and the Internet. It won't save pictures to disk, and it only supports a couple of the modes, but you can get your feet wet with a simple, one-chip, home-brewed interface and see how much fun SSTV is. There's also an SSTV primer from the same sources. Happy video, and I'll *see* you on the bands!

Number 9 on your Feedback card

73 Review

by Peter H. Putman KT2B

Maldol USA
4711 NE 50th
Seattle WA 98105
Telephone: (206)-525-9158
Price Class: HS-2 144 MHz yagi, $54.99 (MSRP);
Maldol HS-75 440 MHz yagi, $54.99 (MSRP)

Maldol Antenna's HS-2 and HS-75

Check out this pair of lightweight VHF/UHF yagis.

Yagi antennas are everywhere—HF, VHF, UHF, log periodics, monobanders, duobanders, and even triband yagis are everyday fixtures in many amateur radio stations. While most hams who use Yagis probably have fairly large models permanently attached up on a tower or roof support, there are times when a small, portable yagi comes in real handy—especially when operating at VHF and UHF frequencies. Such instances could include foxhunts, temporary emergency or special event stations, and remote links for repeaters and packet stations.

One recent entry into the small yagi market is Maldol Antennas of Japan, who has designed a couple of lightweight beams for portable use. Maldol had a large, eye-catching display at the 1994 Dayton Hamvention featuring an array of yagis and omnidirectional antennas for a variety of uses. I was intrigued, and after a brief conversation with Jim Smith KA7APJ, the U.S. importer for Maldol, I was able to procure a few test models for review.

The Maldol HS-2

Maldol's HS-2 2 meter yagi is an extremely lightweight (about 1 lb.) three-element yagi intended for direction finding and foxhunting.

> **"What makes the HS-2 of interest is that its boom length will fit in many nylon zipper cases commonly found in camping supply stores . . ."**

but has many uses beyond these. It measures a short 44.5" and employs a traditional gamma-match feed with UHF connector (Photo A). What makes the HS-2 of interest is that its boom length will fit in many nylon zipper cases commonly found in camping supply stores, making it a breeze to pack up the HS-2 for portable or backpack operation.

The three elements fasten to the boom with a clever design. Each of them has a threaded bushing centered on the element. You insert each element into the boom and secure it by attaching a washer and wingnut on the opposite side, which makes for a very quick setup (Photo B). All elements and mounting hardware are made from stainless steel for corrosion resistance, but it's not likely that you'll want to leave this antenna permanently mounted outside—the HS-2 is so light that it could be easily damaged during an icestorm or by an ill-timed falling branch.

The driven element has a couple of pieces to assemble to build the gamma match, consisting of a standoff block with a UHF connector and a coaxial sleeve with a tapped

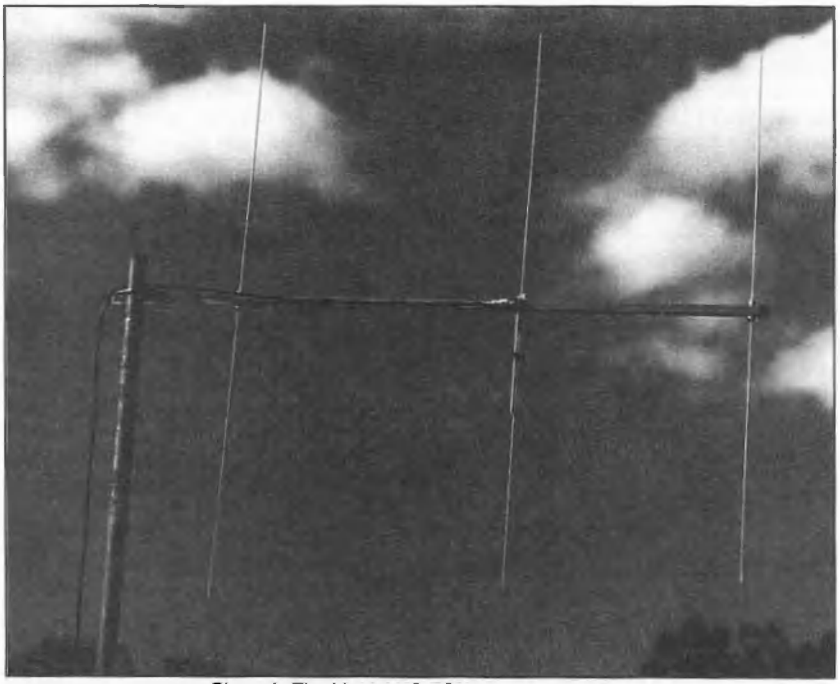


Photo A. The Maldol HS-FOX2 2 meter antenna.

Photo B. Close-up of the mounting scheme on the Maldol HS-2 and HS-75.

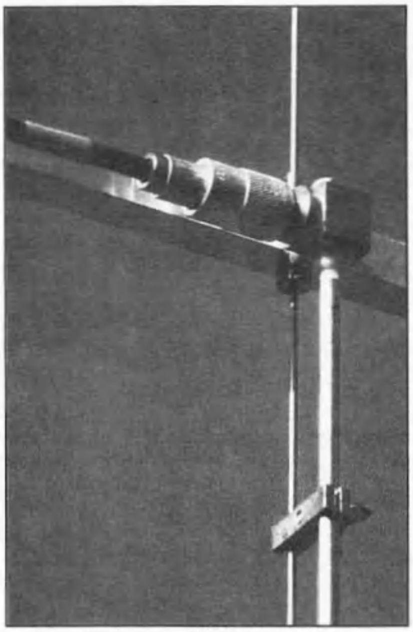


Photo C. Gamma match on the HS-2 yagi

end that threads into the block (Photo C). Instructions with the yagi give you the correct tap point, but the feed is broad enough that the actual tap point can vary somewhat without problems. The 5/8"-square aluminum boom has two sets of holes drilled in it for the supplied U-clamp, allowing either horizontal or vertical polarization.

Performance

Maldol rates the HS-2's gain at 9.5 dBi (gain over an isotropic dipole). I wasn't in a position to accurately substantiate this number, but I was able to set up a small test range to check the pattern of the antenna as well as its VSWR. This test range was nothing more than a 1/4" radiator on 2 meters mounted atop a ladder at 15' with the HS-2 mounted on 15' of slip-up mast, coupled to an RF millivoltmeter. At this frequency I experienced some ground effects but my results showed them to be negligible.

At 45 degrees either side of center the signal was down 2.5 dB from the reference, while at 90 degrees it was reduced 16.5 dB. This type of plot would be expected for a small yagi like this, meaning that it doesn't have an awful lot of sidelobe rejection. Similarly, the front-to-back ratio clocked in at about 13 dB—not great for contest or weak signal work, but more than adequate for DFing!

When I swept the HS-2 for VSWR, I saw a fairly broad response. Using a Bird 43, the worst reading I came up with was 2.2:1—but that was at 140 MHz. At 144 MHz, the HS-2 dropped down to 1.5:1 and at 146 MHz the reading was less than 1.05:1. It only climbed as far as 1.3:1 at 148 MHz, so this antenna may also appeal to CAP operators. Maldol lists the maximum power at 50 watts and, given the size of the balun sleeve, I think that's conservative.

The Maldol HS-75

Like its 2 meter brother, the HS-75 is a lightweight (less than 1 lb.) antenna designed for quick assembly and portable use (Photo D). It uses the same element mounting system and gamma match design as the HS-2, but employs five elements on a 28.5" boom. The HS-75 has a very small profile and I suspect it wouldn't last too long in a harsh climate as part of a permanent installation. But for portable work it's definitely the ticket, whether you prefer vertical or horizontal mode.

The HS-75 also uses a UHF connector, which I usually frown on at this frequency. However, for DF work, the slight impedance "bump" that results is not going to degrade system performance all that much and makes it easier for people using handie-talkies and mobile radios to connect up.

Performance

Maldol claims 12.15 dBi of gain for the HS-75, not atypical for a yagi of this size. My interest lay in seeing just how sharp the pattern was with the extra three elements. I didn't expect a huge improvement over the three-element HS-2, but was pleasantly surprised: At 45 degrees from the test 1/4-wave antenna, the signal was down 10.5 dB. At 90 degrees, it was reduced 13.5 dB, and the front-to-back ratio was 17.5 dB—definitely a winner for foxhunting.

"Like its 2 meter brother, the HS-75 is a lightweight (less than 1 lb.) antenna designed for quick assembly and portable use."

The VSWR response showed a fairly even curve with a gentle slope up at 440 and 450 MHz, measuring just about 2:1 at these two points. Maximum resonance occurred at 445 MHz—right in the middle of the band, the Bird 43 showed less than 1.05:1. At 443 and 447 MHz, it climbed to 1.5:1 and at 441/449 MHz, I saw about 1.8:1. The HS-75 shouldn't present loading problems to any HT or mobile rig.

How They Worked in the Field

The acid test for these antennas was to put them to work in an actual foxhunt. Local hams from the Warminster ARC had organized such an event, and I loaned them the HS-FOX2, some short lengths of coax, and a few precision stepped-attenuator boxes. Since this was the club's first shot at a DFing event, many of the participants decided to "wing it" as far as receivers, antennas, and other DF equipment. As things turned out, the folks who borrowed the HS-FOX2 were the first to locate the "fox." They were quite pleased with the ease of assembly and lightweight design—noticeably lighter than other well-known small yagis. Comments were also made about the pattern not being terribly sharp, but in conjunction with the step attenuators (providing up to 60 dB in signal reduction), the signal peaks were easy enough to detect.

For the final test, I brought both yagis with me on a short portable operation for the June VHF QSO Party. While many backpackers usually carry a very small station, such as one radio and antenna, I've packed as many as five bands for a mountaintop operation. While the HS-FOX2 certainly made things lighter, its pattern just wasn't sharp enough for making long-haul contacts. The extra six elements on my Tonna made a *big* difference.

For 440 MHz operation, the HS-75 didn't quite compare with my nine-element Tonna—both are fairly broad, but there was an advantage to the Tonna on really weak signals. Also, the tap point on the gamma match required readjustment to reduce the SWR at 432 MHz, while the Tonna uses a folded dipole and is more broadband. For casual weekend contesters, these two antennas are more than adequate, but for a serious QRP portable operation you'll want to try something more substantial. 73

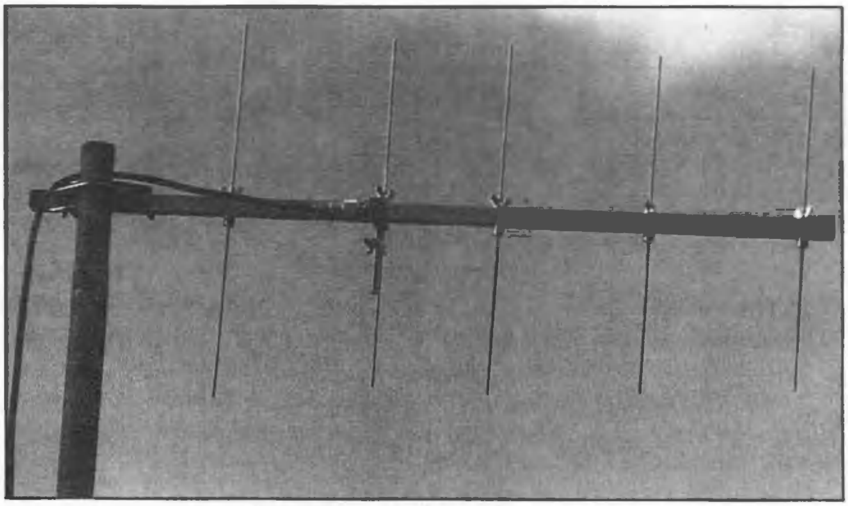


Photo D. The Maldol HS-FOX75 antenna.

2 Meter Collinear Vertical Antenna

Build almost 6 dB of gain for almost $10.

by Marty Gammel KAØNAN

Since my article about the 440 MHz PVC omnidirectional antenna was published in the November 1994 issue of *73 Amateur Radio Today* (page 22), I have had over 30 requests for the 2 meter version of that antenna. So, this article describes how to make my 2 meter version. Due to the wind load from the large sizes of PVC pipe needed to enclose the antenna, the 2 meter version can't be put inside PVC pipe—too cumbersome. You would need 4" inside diameter PVC pipe for the center section.

This collinear antenna is normally mounted vertically for FM voice and packet use. The antenna has almost 6 dB of gain and is fairly broadbanded. You should be able to obtain all the needed materials for under $10, except for the coaxial feedline of your choice.

The idea for this antenna is an old one. I saw a sketchy plan in the 1974 *ARRL Handbook*, and I knew I could improve on it using modern materials and techniques. I changed the dimensions to make the SWR dip at the center of the 2 meter band. I also changed the feed point attachment and tuning design.

Cutting and Assembling the Antenna

Start by gathering all the materials and tools needed. Cut two pieces of 1/2" copper pipe to a 37-1/2" length, two pieces of 1/2" copper pipe to a 19-1/2" length, and one piece of 1/2" copper pipe to a 2" length. Using flux, assemble the 1/2" copper pipe pieces with the 1/2" copper elbows, and place a 1/2" copper cap on each vertical end. Now fire up your propane torch, and sweat solder all the joints. (The excess flux will be cleaned up later). *Hint:* I put a weight on the pieces to keep them in alignment as they are being soldered. Hang the joint that you are currently soldering out away from your work table to avoid burning your house down.

Drill two holes in each of the vertical sections (see Figure 1), and attach the 1/4" x 1" x 6" piece of Plexiglas (I used 1/2" Plexiglas that I had in my junk box) to the antenna using 1/8" x 1" stainless steel bolts with nuts and washers. Install the PVC cap on the top of the 1" PVC mast. Lay the antenna with its Plexiglas standoff pieces on the PVC pipe, and drill two holes in each piece for attaching to the mast, using 1-1/2"-long stainless steel bolts with nuts and washers.

Making the Phasing Section

To complete this antenna, you also need to make a 52-ohm phasing section, one electrical half-wavelength long (see Figure 2). For mine, I used RG-8 that had a velocity factor of 0.80 times a half wave, equaling a needed finished length of 30-1/2". If you use a 0.66 velocity factor, you will need a 25" finished length of 52-ohm coax. If you use a 0.78 velocity factor, you'll will need a finished length of 29.64". Start with a piece of coax about 3" longer than your finished length to allow neat pigtailing of the ends. Twist all the shields together neatly, and then solder them together (see Figure 1 and the photos). Set this phasing section aside until you have finished constructing the antenna.

Cleaning and Finishing the Antenna

You should clean the entire surface of the completed antenna with solvent. Then spray two or three coats of a clear lacquer exterior finish to keep the antenna looking nice and to seal the surface from the weather. I attached the antenna to the PVC mast before spraying the finish. That way the finish coats the nuts and bolts to keep them looking nice, too.

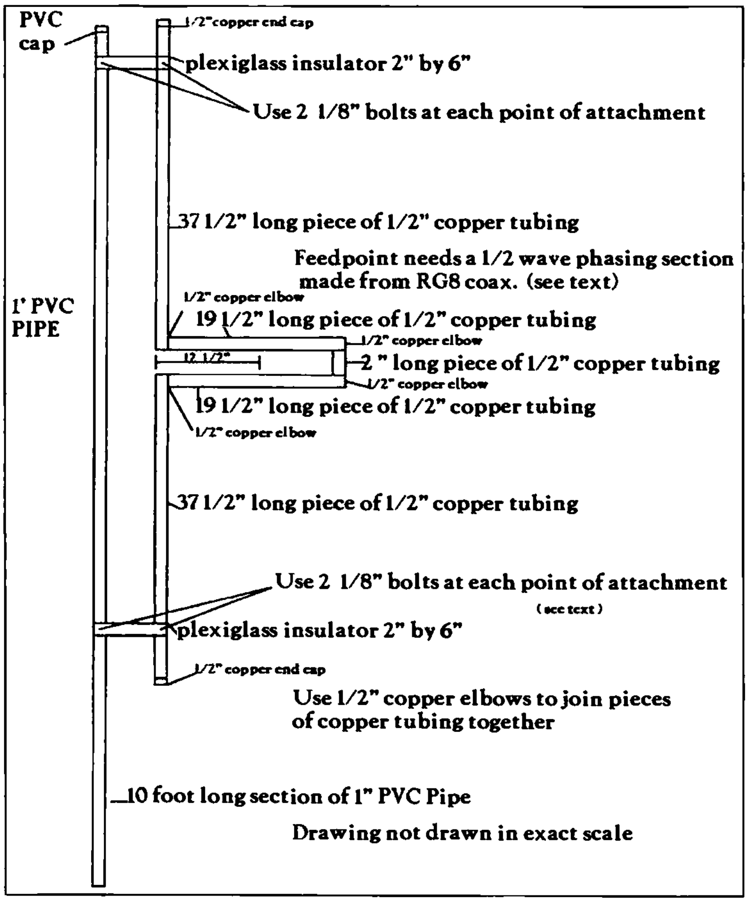


Figure 1. Construction details of the 2 meter collinear antenna.

Attaching the Phasing Section

The center conductor of your main feedline and one end of the phasing section connect to the upper feed point. Solder this neatly, as it will be clamped to the antenna when tuning. Tin the other end of the phasing section, and attach this to the lower feed point with a clamp. Tape the phasing section and the feedline together, and bring the completed coax phasing section over to the PVC mast *after* tuning the antenna.

Tuning the Completed Antenna

This antenna is very easy to tune. All you have to do is slide the phasing section-feedline assembly along the horizontal 1/2" copper tubing until you have found the lowest SWR point. For mid-band, this measurement should be about 12-1/2" from the vertical sections of 1/2" copper tubing. (See the figures and photos.)

After the lowest SWR has

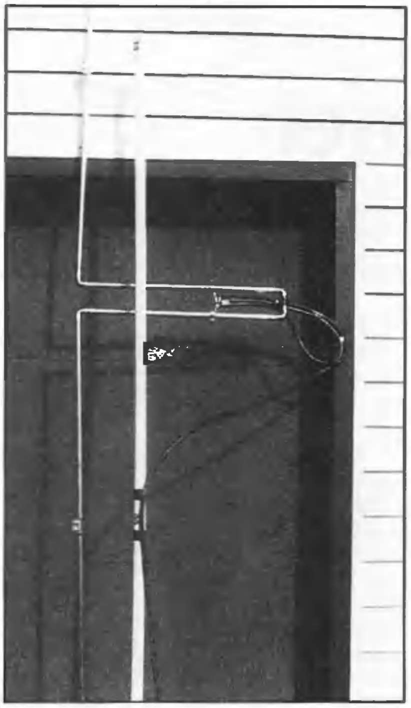


Photo A. The completed 2 meter collinear.

been found, use some plastic tie-wraps to secure the coax and phasing section to the mast and antenna.

Builder's Notes

I used a clean rag soaked with lacquer thinner to clean the antenna before applying the clear exterior finish.

Tape the phasing section and coax to the antenna for tuning. Add the plastic tie-wraps after the antenna is completed.

Trim excess length off the tie-wraps before putting the antenna on your roof or tower.

ABS type plastic pipe can be used instead of PVC pipe. I didn't use a wooden mast, avoiding the warping, shrinking, and swelling of wood.

Keep the antenna at least a half-wavelength away from metal to avoid any detuning from close masses of metal or wires.

I used the "solder the phasing section to the feedline" method of feeding the antenna to avoid any extra coax fittings adding their losses to the antenna system.

A convenient length of 52-ohm coax, 8 to 10 feet long, with a coax fitting on one end, may be attached to the phasing section to make installation easier. I had a 60-foot run of coax and didn't want any extra joints in the feedline run into my shack.

If you are going to mount this antenna in a roof tripod, you may want to slip a wooden dowel or closet rod inside the lower section of the mast to add strength to the mast.

Anyone wanting more information may write to me directly (1703 Hewitt Ave. W., St. Paul, MN 55104-1128), sending an SASE (a #10 business size works best). I will answer all requests sent this way. Good luck on your antenna project, and happy hamming—73.

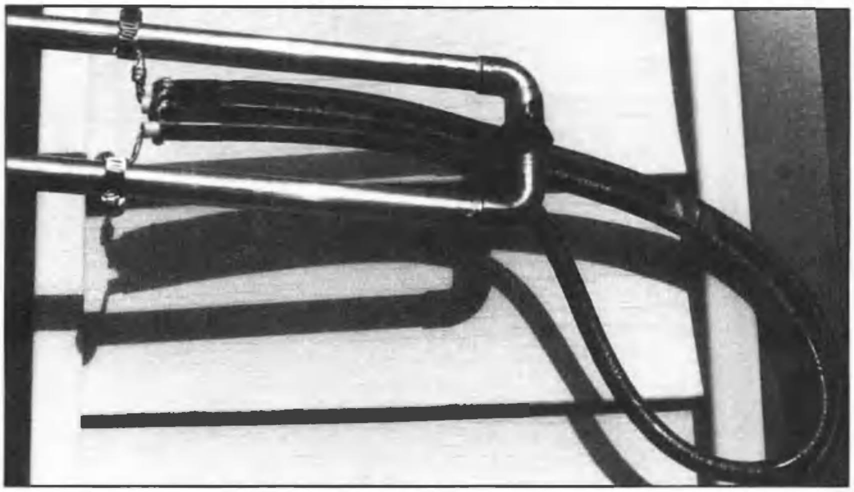
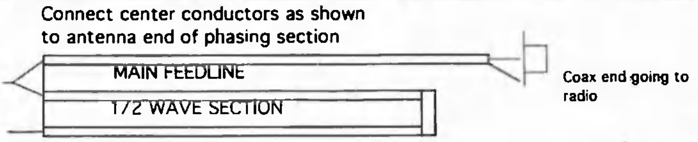


Photo B. Detail of the half-wavelength phasing section.



Drawing Not to scale

Tie all shields together (solder)

Use 52 Ohm coax to make phasing section

the formula for using the velocity factor is length times velocity factor: example:38"X.66=25.08"
Always find the correct velocity factor and you will make good phasing sections.

EXAMPLES: 38"X.66=25.08"

38"X.78=29.54"

These examples used line lengths for 2 meter

Figure 2. Main feedline half-wave section.

Parts List

1/2" Schedule M copper tubing:	
2 pieces	37-1/2" long 1/2" copper tubing (for vertical sections)
2 pieces	19-1/2" long 1/2" copper tubing (for horizontal sections)
1 piece	2" long 1/2" copper tubing (for center stub)
4 pieces	1/2" copper elbows (for attaching tubing together): see drawing/photo
2 pieces	1/2" copper end caps (for top and bottom of vertical sections)
PVC plastic pipe and fittings:	
1 piece	1" PVC pipe 10 feet long (for mast)
1 piece	1" PVC cap (for the top of the mast pipe section); see drawing/photo
Plexiglas or other non-conductive material.	
2 pieces	1/4" thick by 1" wide by 6" long (for attaching antenna to mast)
Miscellaneous items:	
4	1/8" by 1-1/8" stainless steel bolts with nuts (for attaching antenna)
4	1/8" by 1-3/4" stainless steel bolts with nuts (for attaching antenna)
2	3/8" wide by 7/8" diameter stainless steel hose clamps (for feed point)
Some plastic tie-wraps (for securing coax and phasing section)	
Silicone or other sealing compound (to weatherproof coax connections)	

Tools needed:
Plumber s-type tubing cutter
Propane torch
Tape measure
Wrenches
Electrical tape
Solder and flux

A Decibel Primer

Simple math for the Technician Class.

by Steven R. Sampson N5OWK

If you ask a Technician what a decibel is, you may find someone on the hot seat. Shifting and squirming, they may finally proclaim: "It's a measurement system." That part is obvious, but not really the answer we are searching for.

The decibel system of measurement is often confusing. A trick we use with metric measure, for example, is to memorize a conversion constant. This technique will also work well for decibels. Rather than just leave you hanging with three numbers to memorize, I would like to introduce some real world examples and the underlying math. I think you will enjoy how simple decibels really are, and how the use of this measurement system will fit into your radio and electronic activities.

Heaven's Bels?

In Babylonian mythology, Bel is the god of heaven and earth. Our bel was a mere mortal: Alexander Graham Bell. The bel is defined as the logarithm of the ratio of two levels of power.

$$\text{bel} = \log (P_2/P_1) \qquad \text{(Equation 1)}$$

We use logarithms so that the gain or attenuation of multiple sections can be added and subtracted, rather than multiplying or dividing. It's a handy feature of multiplying exponential numbers where, given a common base, it turns out that we can just add the exponents together. In electronics we use exponents with a base of 10. This really amounts to human simplification, since computers and calculators do not really get all that upset over fractions or multiplication. The function of algebra and trigonometry training is to recognize and manipulate equations to their simplest form. I could type into my calculator "10 to the 2nd power, times 10 to the 2nd power," and get an answer; or, I could also recognize that there is a common base of 10, and just type in 10 to the 4th power after first adding the two exponents.

A bel turns out to be a small fractional number. This is hard to work with, so we multiply it by 10 to improve accuracy, and call it a decibel, abbreviated "dB."

$$\text{dB} = 10 \log (P_2/P_1) \qquad \text{(Equation 2)}$$

For example, the value 1.4445 bels may be prone to rounding of the fractional part. A person might just say 1.5 bels is close enough. They would only be introducing an error of 4% into the measurement. By multiplying the bel ratio by 10, to produce decibels, we get 14.445 decibels. Now, if the number is rounded to 14.5 decibels, we can prevent significant errors from creeping in (0.4% here).

> ***"The function of algebra and trigonometry training is to recognize and manipulate equations to their simplest form."***

Using Decibels

Amateurs often use dB to express power loss in coaxial cable. The more advanced may even describe transmitter power or receiver gain in decibels. Most of the radar systems I worked on in my military career specified all measurements to 1 milliwatt. This system uses the abbreviation of dBm, with 0 dBm being equal to 1 milliwatt (0.001 watts). All my coaxial cables of any length were measured, and the input and output power of each stage were adjusted to specifications given in dBm. The reason for this is that an engineering team designing a multistage power amplifier system must know what the previous stage will provide, and the next stage will require. They can use any measurement system they want, but they usually choose one that can have its measurements added. If the target amplifier is 90 dBm and the first stage outputs 10 dBm, they know that they need 80 dBm of amplification in the intermediate stages.

Coaxial cable and waveguide loss are also important. If the waveguide shows a 1 dBm loss and the input expects 10 dBm, then the previous stage will need to be adjusted for 11 dBm output to compensate.

The examples above demonstrate absolute measurements. Zero dBm is 10^0 (which is 1) times 0.001 watt; 10 dBm is 10^1 times 0.001 watt; 90 dBm is 10^9 times 0.001 watt, or 1 megawatt. The use of dB without a reference is a relative measurement. If I tell you the amplifier has a gain of 8 dB, there is no way you can ever know whether the output is a milliwatt or a megawatt. We do know that it will amplify any input by 10 raised to the 0.8 power, or about 6.3 times the input.

Before calculators became as common as watches, there were conversion factors that needed to be memorized: 10 dB, 3 dB, and 1 dB. (See Table 1.) All expressions in dB were reduced to these factors. To factor 8 dB, we would do the following:

$$8 \text{ dB} = (3 \text{ dB}) + (3 \text{ dB}) + (3 \text{ dB}) + (-1 \text{ dB})$$
$$8 \text{ dB} = 2 \times 2 \times 2 \times 4/5$$
$$8 \text{ dB} = 8 \times 4/5$$
$$8 \text{ dB} = 32/5$$

You always use a method where the 1 dB figure can be used the least number of times. It is the most inaccurate conversion value of the three. The conversion constant method results in an answer very close to the calculator answer. Here the answer is 6.4, which is an error of 1.4% to the calculator answer of 6.3096.

Mental Gymnastics

If you go to a club meeting and mention 8 dB to any seasoned ham over age 40, you will probably see their eyes blink as they perform this mental miracle. When the conversation proceeds and the person states that the amplifier put out 4 watts originally, you now have a reference and can convert to an absolute measurement. You now know that 8 dB of gain is about 25.6 watts (6.4 times 4 watts). Using a calculator you could much more easily type 10 to the 0.8 power times 4, and get the more accurate answer of 25.2383 watts.

The entire table for converting decibels into real numbers is shown in Table 1. You

may wish to memorize it for emergency use.

Our first experience with logarithms is normally in algebra class. You may have noticed above that I wrote most equations in logarithmic form, but then I went on and described examples shown in exponential form. I did so because I know that we use base 10 in most electronic measurements. But let's take the equation as it comes, and show how the log function forms a tool to generate numbers that can be added or subtracted.

We often must calculate dB when given power measurements. The earlier example of an amplifier with 4 watts input and 25.6 watts output can also be converted to dB using the logarithmic form. Here we divide the output 25.6 by the input 4 (which we already know is 6.4) and take the log of this ratio. The answer is 0.8062 bels, or 8.062 decibels:

$$8.062 \text{ dB} = 10 \log (25.6/4) \quad \text{(Equation 3)}$$

The log function provides us with the power we need to raise the (understood) base of 10 to get this ratio. You could also use a logarithm table and look up our ratio of 6.4 and find this same 0.8062 value.

This technique is also used when converting power to dBm. In this case, the measured power is divided by the reference power of 0.001 watts:

$$\text{dBm} = 10 \log (\text{watts}/0.001) \quad \text{(Equation 4)}$$

The Plus and Minus of It

The purpose, as we mentioned at the start, is to be able to add or subtract the gains or attenuation measurements together. If we keep a common base of 10 throughout, we can add or subtract the exponents. Thus, the logarithm function provides us with a tool where you insert any value, turn the crank, and it will generate an exponent that the common base 10 must be raised to. This exponent can be added to every other exponent it generates due to this common base. All the decibel measurement conversion of a bel docs for us is multiply the values by 10, providing us with whole numbers rather than fractions. This is used to maintain instrument accuracy even when rounded. The difference between a bel and a logarithm is that the bel is understood to be a ratio of two powers, while a logarithm value by itself is undefined— it's just a number.

"With a little practical experience, each of us can easily describe the need for and function of this valuable measurement system."

No Squirming

I do not like to squirm when explaining decibels. With a little practical experience, each of us can easily describe the need for and function of this valuable measurement system. While memorization of decibel conversions is useful in light conversation, the calculator provides a much better method of turning the crank on decibels. I think it is much easier to type 10 to the 0.8 power into a calculator than to convert 8 dB to a real number using conversions (3 dB + 3 dB + 3 dB - 1 dB), but I'll let you decide. Quickly now, first convert 50 watts to dBm. Second, tell me how much power in dBm and watts a 4-watt transmitter will produce at the antenna of a receiver 10 miles away. Each of the two antennas have 11 dB of gain. Assume a 110 dB path loss. (The answers should be 46.99 dBm, -51.98 dBm, and 6 nanowatts).

Number of dB	More (Positive)	Less (Negative)
1 dB	5/4	4/5
3 dB	2	1/2
10 dB	10	1/10

Table 1. Table for converting decibels into real numbers.

Number 12 on your Feedback card

DTMF Decoder

High-speed home-brew DTMF control.

by Richard Taylor K7CAH

The Capitol Peak Repeater Group operates several repeaters on Capitol Peak near Olympia, Washington. These repeaters are controlled by two microprocessor controllers, with lots of bells and whistles, including an autopatch. There are over 600 user and control codes involved in the setup and operation of the two controllers. Due to the large number of DTMF codes involved in setup, configuration, and user operations, a fast means of inputting DTMF was clearly needed (see "DTMF Computer Interface," 73 magazine, December 1994). Also, a way was needed to keep track of all the codes that were sent to the repeaters.

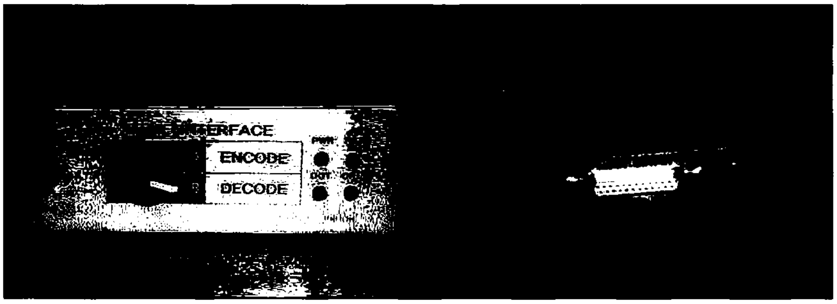


Photo A. The DTMF decoder, front (left) and back (right).

The following DTMF decoder will decode all 16 digits and date- and time-stamp the received code. It uses the printer port of any IBM-compatible computer. Although the decoder will work with the XT series computers, they are too slow to properly decode the fast digits generated by memory-stored codes of the newer radios. A 286 or higher computer is recommended.

Circuit Description

The decoder was designed around the CD22204 DTMF receiver chip. It uses a standard 3.58 MHz TV-type crystal in its oscillator and has four binary data lines out.

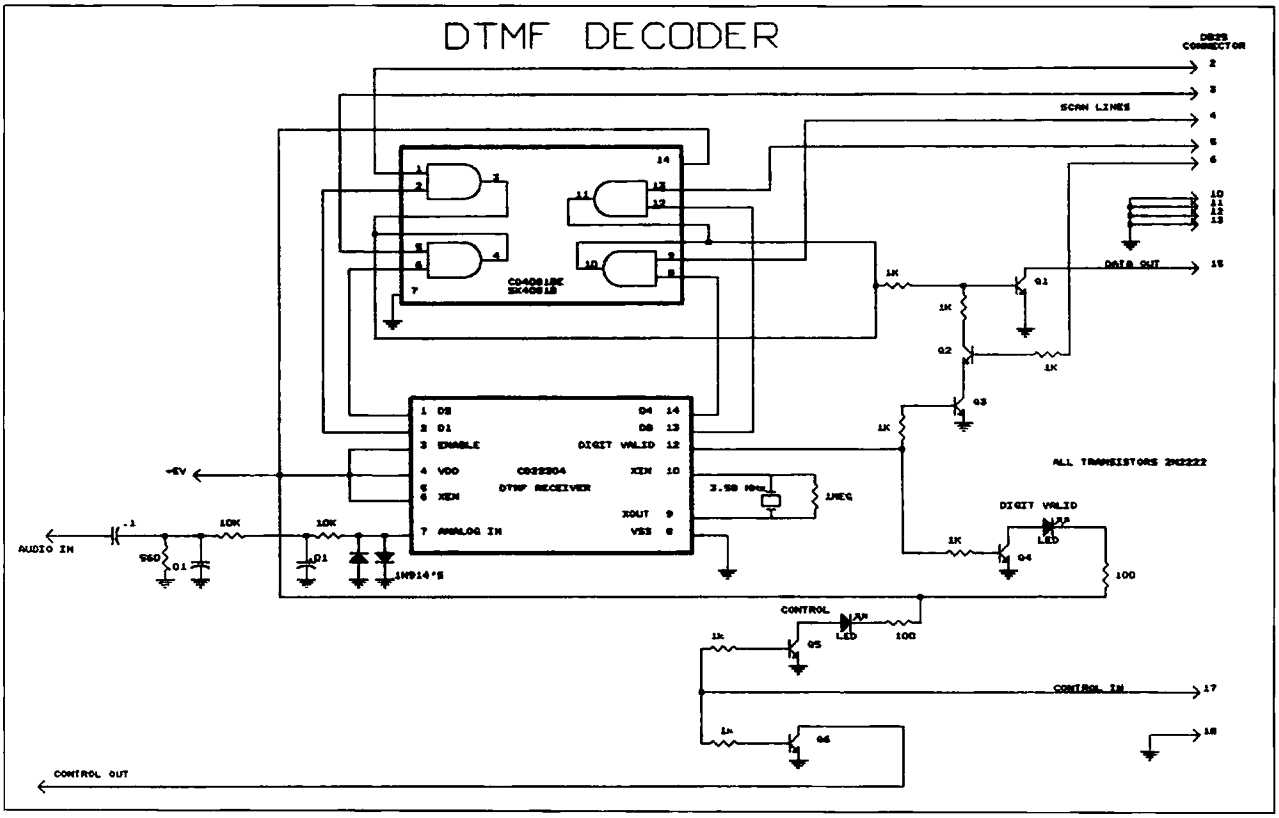


Figure 1. The DTMF decoder.

Photo B. Inside the box.

The output lines represent the binary value of the received DTMF digit. When I first started this project, it seemed simple enough. Just take the binary output from the chip, put it in the parallel printer port, and write the program code to handle the binary input. But, I quickly found out that each computer handles the input lines of the printer port a little differently. In the end, I had to change the parallel binary out from the receiver chip to serial binary and input that to the printer port. Using serial data, we don't care what numbers are returned by the computer. All that matters is whether the input pin 15 is in a high or low state. This still keeps the hardware simple, but the program code becomes a little more complex.

The output lines from the CD22204 DTMF receiver chip represents the parallel binary value of the received DTMF digit. These data lines are tied to one input each of four AND gates (see Figure 1). The other input to the four AND gates is controlled by the data out lines of the printer port. The output from the AND gates is tied together and trigger Q1 on and off. This sends the resulting data to the computer via the printer error line pin 15.

The program turns the printer data lines 2 through 6 on and off in sequence. This, in effect, forms a scanner that scans the parallel binary output from the receiver chip and converts it to serial binary through the AND gates and Q1. However, with only four lines of binary output from the receiver chip, only 15 DTMF digits can be decoded. The 16th digit (D) is decoded as all output lines low and the digit valid line high. Q2 and Q3 form another AND gate that inputs the digit valid line into the serial output stream.

When the program detects a user-defined code, line 17 goes high. This causes Q6 to conduct, grounding the control out line. This line can be used to control external devices (turn on the speaker, turn on a light, etc.) when your private code is received. Caution: Q6 can only handle about 500 mA. Use an external relay to handle anything above this current (see Figure 2).

PRINTER PORT

PIN	DESCRIPTION
1	STROBE
2	DATA BIT 0
3	DATA BIT 1
4	DATA BIT 2
5	DATA BIT 3
6	DATA BIT 4
7	DATA BIT 5
8	DATA BIT 6
9	DATA BIT 7
10	ACKNOWLEDGE
11	BUSY
12	PAPER OUT
13	PRINTER ON LINE
14	AUTO FEED
15	ERROR
16	INIT
17	SLCT
18–25	GROUND

PORT ADDRESS

LPT1 - 888 OR 956
LPT2 - 632

PORT ADDRESS ACCESSES PINS 2 TO 9	OUTPUT
PORT ADDRESS + 1 ACCESSES PINS 10,11,12,13,15	INPUT
PORT ADDRESS + 2 ACCESSES PINS 1,14,16,17	OUTPUT

Figure 3. Printer port pinout and addressing.

Q4 and Q5 are used as drivers for the LEDs. The digit-valid LED lights whenever a DTMF tone is recognized. The control LED lights when the user-defined control code is decoded.

The Program

The program is written in GWBASIC and should run on any IBM-compatible computer. The listing contains two parts. The first part controls the input and output lines of the printer port (Figure 3). The second part decodes the binary digit, date- and time-stamps it, and prints it to the screen.

Not all computers, however, use the same port address for the printer port. The port address for LPT1 should be 888 or 956. For LPT2, it should be 632. Line 30 of the program determines the correct port address. If the program will not run, change the value of W in line 30.

Line 580 of the program determines the user-defined code that turns on the control out line. Change the value of D$ to any code you wish. Don't forget the quotes. When the program first detects this code, it will turn the output line on. The next time it detects this code it will turn off the output line.

Construction

Parts placement is not critical. All transistors are 2N2222s, although any general-purpose NPN switching transistor should work. Although parts values are also not critical, it is best to stay as close as possible to those listed. The components from the audio in line to pin 7 of the receiver chip comprise an audio filter to prevent falsing on voice peaks. However, the 1N914 diodes may be

Parts List

1	DTMF receiver, CD22204
1	Quad AND gate, CD4081BE or SK4081B
6	2N2222 transistor or equivalent
1	3.5795 MHz TV color burst crystal, ECG358 or equivalent
7	1k ohm resistor
2	100 ohm resistor
2	10k ohm resistor
1	560 ohm resistor
1	0.1 µF capacitor
2	0.01 µF capacitor
2	1N914 diode
2	Red LED

A complete program with user data base, code recognition, file storage, and documentation is available on 5-1/4 disk for $15 U.S. from the author. Write to me at 613 N. 5th, Tumwater, WA 98512.

Drilled and etched PC boards are available for $4.25 plus $1.50 S&H per order from FAR Circuits, 18N640 Field Ct.,Dundee, IL 60118.

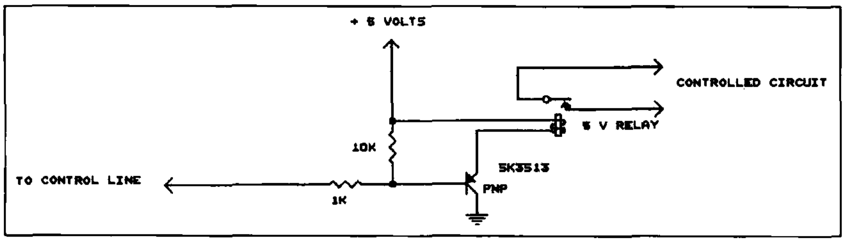


Figure 2. An external relay to control circuits that draw more than 500 mA.

PROGRAM

```
10 REM DTMF DECODER BY K7CAH
20 CLS:H=0:CTRL=0:KEY OFF
30 W=888:REM                  PRINTER PORT ADDRESS
40 OUT W,0:REF=INP(W+1)
50 PRINT"                                  DTMF DECODER"
60 PRINT"________________________________________________________________________"
70 B$=INKEY$
80 DIGIT$="":N=1:A$="":OUT W,0
90 IF N>16 THEN 290:REM STOP SCAN AND CHECK DIGITS
100 OUT W,16:REM START SCAN ON VALID DIGIT
110 IF INP(W+1)<>REF THEN HOLD$="":GOTO 230
120 OUT W,N:REM SCAN DIGIT LINE
130 B=INP(W+1)
140 IF B=REF THEN A$="0":GOTO 170
150 IF B=REF+1 OR B=REF-1 THEN A$="0":GOTO 170
160 IF B<>REF THEN A$="1"
170 DIGIT$=DIGIT$+A$
180 N=N+2
190 IF N=3 THEN N=2
200 IF N=6 THEN N=8
210 IF N=10 THEN N=16
220 GOTO 90
230 IF B$="Q" OR B$="q" THEN KEY ON:END:REM QUIT
240 IF B$="C" OR B$="c" THEN 20:REM CLEAR SCREEN
250 REM IF TIME > 4 SEC CHECK FOR CODE AND PRINT NEW LINE
260 IF TI+4=VAL(RIGHT$(TIME$,2)) AND H=1 THEN GOSUB 580:H=0:CODE$="":PRINT
270 GOTO 70
280 REM IF DIGIT IS HELD DOWN THEN PRINT ONLY ONE DIGIT
290 IF HOLD$=DIGIT$ THEN 230
300 REM TEST DIGITS
310 IF DIGIT$="10000" THEN GOSUB 530:PRINT "1";:C$="1":GOSUB 490:GOTO 230
320 IF DIGIT$="01000" THEN GOSUB 530:PRINT "2";:C$="2":GOSUB 490:GOTO 230
330 IF DIGIT$="11000" THEN GOSUB 530:PRINT "3";:C$="3":GOSUB 490:GOTO 230
340 IF DIGIT$="00100" THEN GOSUB 530:PRINT "4";:C$="4":GOSUB 490:GOTO 230
350 IF DIGIT$="10100" THEN GOSUB 530:PRINT "5";:C$="5":GOSUB 490:GOTO 230
360 IF DIGIT$="01100" THEN GOSUB 530:PRINT "6";:C$="6":GOSUB 490:GOTO 230
370 IF DIGIT$="11100" THEN GOSUB 530:PRINT "7";:C$="7":GOSUB 490:GOTO 230
380 IF DIGIT$="00010" THEN GOSUB 530:PRINT "8";:C$="8":GOSUB 490:GOTO 230
390 IF DIGIT$="10010" THEN GOSUB 530:PRINT "9";:C$="9":GOSUB 490:GOTO 230
400 IF DIGIT$="01010" THEN GOSUB 530:PRINT "0";:C$="0":GOSUB 490:GOTO 230
410 IF DIGIT$="11010" THEN GOSUB 530:PRINT "*";:C$="*":GOSUB 490:GOTO 230
420 IF DIGIT$="00110" THEN GOSUB 530:PRINT "#";:C$="#":GOSUB 490:GOTO 230
430 IF DIGIT$="10110" THEN GOSUB 530:PRINT "A";:C$="A":GOSUB 490:GOTO 230
440 IF DIGIT$="01110" THEN GOSUB 530:PRINT "B";:C$="B":GOSUB 490:GOTO 230
450 IF DIGIT$="11110" THEN GOSUB 530:PRINT "C";:C$="C":GOSUB 490:GOTO 230
460 IF DIGIT$="00000" THEN GOSUB 530:PRINT "D";:C$="D":GOSUB 490:GOTO 230
470 GOTO 230
480 REM FORMULATE CODE FOR OUTPUT
490 HOLD$=DIGIT$
500 CODE$=CODE$+C$
510 RETURN
520 REM DATE AND TIME STAMP
530 IF H=0 THEN PRINT "     ";DATE$;"     ";TIME$;"     ";:H=1
540 TI=VAL(RIGHT$(TIME$,2))
550 IF TI=59 THEN TI=0
560 RETURN
570 REM CODE FOR OUTPUT CONTROL
580 D$="123":REM CODE TO TRIGGER OUTPUT LINE
590 IF CODE$=D$ AND CTRL=0 THEN OUT W+2,3:CTRL=1:GOTO 610:REM OUTPUT LINE ON
600 IF CODE$=D$ AND CTRL=1 THEN OUT W+2,13:CTRL=0:REM OUTPUT LINE OFF
610 RETURN
```

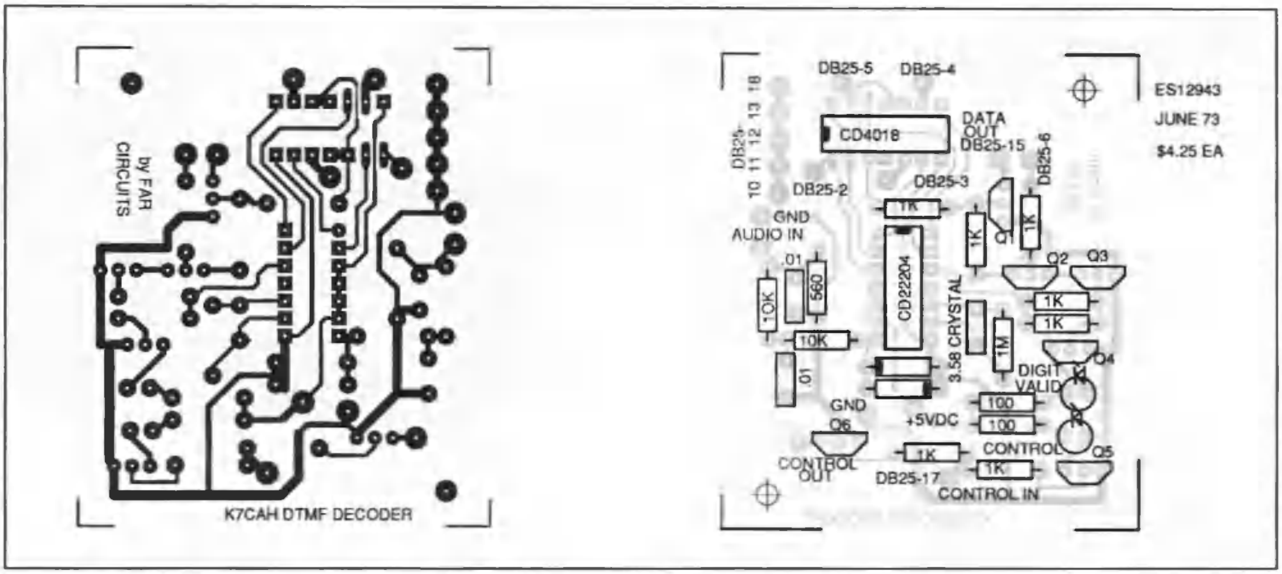


Figure 4. PC board layout and parts placement.

left out for increased sensitivity. Pins 10 through 13 and pin 18 of the printer port must be grounded for the decoder and program to function properly.

I used a computer A/B switch box as an enclosure. The type with the DB-25 connectors works really well. It already has the connectors and switch wired. One port was disconnected and wired to the decoder board. The other port can be left as is and used for the printer.

Any source of audio may be used. However, the audio input circuit is designed for low-level audio. A good source for this audio is the output jack on the back of the radio for packet. If speaker audio is used, too high a level will cause distortion and the decoder will not function properly. If erratic operation is encountered at normal listening levels, add a resistor in series with the audio input of the decoder board.

HOMING IN

Number 13 on your Feedback card

Radio Direction Finding

Joe Moell P.E. K0OV
P.O. Box 2508
Fullerton, CA 92633

Stalking the Wild T

If someone in your ham club invites you to go on a foxhunt or a bunny hunt, don't rush to the phone to call PETA. They won't be harming helpless critters. These contests, which are better known as T-hunts in many places, are quests for hidden radio transmitters. That's what the T stands for.

Typically, one ham puts a low-powered signal with distinctive audio on the air from an unusual location. Other hams try to track it down using simple radio-direction-finding (RDF) equipment. It's fun and educational, as you probably know from reading "Homing In" every month. This time, I'll tell about participating in a different kind of T-hunt, where T stands for "tortoise."

If you watch nature specials on educational TV channels, you are sure to see scenes where "tagged" animals are monitored using RDF. Many of today's research studies are funded by the National Biological Survey (NBS), a federal agency that was opened in November 1993. Among other activities, NBS works with governmental agencies, universities, and private organizations to perform biological research, inventory, and monitoring. An important NBS mission is to provide the Department of the Interior with a biological science base for governmental decision-making. NBS has a technical center, 12 research centers, 78 field stations, and 59 cooperative research units.

No Clues, No Rules

Tracking wildlife with RDF is certainly different from mobiling in search of a hidden ham transmitter. Most clubs have strict T-hunting rules that establish a boundary within which the T must be hidden. Usually the T must be stationary and have a fixed antenna orientation. Transmission lengths range from several seconds to continuous. The signal must be copyable at the hunt's starting point or through the local repeater.

None of these rules apply to wildlife tracking. There is no guarantee you will hear a signal when you start. Animals are free to roam as you track them. They change antenna position with every step or hop. Battery size limits transmission lengths to a fraction of a second.

Despite these challenges, researchers daily plot the exact location of four-legged creatures from mouse-size to moose-size. They also monitor signals from birds in the air and fish in streams. Some are volunteers or work directly for educational institutions, while others are independent consultants.

Though I have corresponded with animal-tracking specialists from time to time, I never had an opportunity to observe their operations firsthand until this spring, when environmental consultant Glenn Goodlett wrote of his experiences on an online service. Glenn got his start tracking rodents in the USA and Australia. Recently, he has worked in a study of tortoises in California's Mojave desert.

As his third annual spring chelonian survey began, Glenn invited me to come and observe. He is not a ham yet, but he is a regular reader of *73 Amateur Radio Today* and "Homing In." "I like learning about the latest technology," he says.

Animal tracking, cataloguing, and data analysis is a full-time job. During the study period, Glenn lives at the research site with his wife, Tracy, another environmental consultant whom he met during a tortoise survey, and whom he married last fall. Rounding out this study team is biologist Paul Frank.

As I arrived, Paul and Glenn were doing a health check on a tortoise they had encountered (Photo A). This one did not have a radio tag, but it was in their database. It had previously been numbered, and the number had been encoded on the animal by notching edges of its carapace (upper shell) according to a standard marking system.

Paul and Glenn checked its respiration, weighed, measured and photographed it, then logged the data before setting it free. They wore fresh surgical gloves so that they would not become carriers, passing diseases from tortoise to tortoise. This one was easy to handle. "It's still kind of cold and they're not very active," Paul told me. "But when it gets a little warmer they can put up quite a fight."

Desert tortoises are not facing extinction, but they are considered to be threatened. "They were listed in 1989 after there was a massive die-off," says Paul. "It was a real interesting situation because there are a lot of them and they have a big range, but so many died so fast that the Fish And Wildlife Service listed them. That produced an amazing amount of work for a lot of people. Virtually any public construction within their range needed a pre-construction survey and population monitoring. A lot of biologists got into it and it seemed like anybody who could live out in the desert could find work. In 1990 and 1991 there were probably several hundred people doing tortoise work. Now there is probably a third of that."

In addition to verifying population levels, the present study seeks data on movements. The basic survey area is one square mile of public land near a busy highway. "The average range of an adult tortoise is about half a mile to a mile," Paul says. "Over time, most of them living along a highway will go out and get run over, so there's a band along each road with very low population."

Photo A. A docile desert tortoise gets a health check from Paul Frank (left) and Glenn Goodlett

The highway near the study area includes an experimental tortoise fence made of hardware cloth 18 inches high along the regular barbed-wire fence (Photo B). Special fence sections guide animals to culverts where they can safely cross under the road.

To determine if the culverts and fences are working, an experimental solar-powered monitoring system has just been installed on two culverts nearby (Photo C). A sensor detects passage of tortoises and logs the time of each passage and the ID number of the animal. The special tortoise tags for this system are passive (no batteries needed) and are completely separate from the radio tracking system.

According to Glenn, "The culvert sensor is a big loop in the ground, like the primary of a transformer. The animal's tag has a winding that acts like a secondary. When it comes across, enough power is coupled to provide power to the chip inside the tag, which has its number stored in memory. It loads and unloads its coil, and the reader picks up that loading and unloading."

NBS hopes the study will show that tortoise population is increasing near the highway. "With the fence, a lot of new habitat is created," says Paul. "Tortoises are able to move into the area and stay a while. The biggest problem with fencing is the gates. People often do not close them. A tortoise will tend to walk along the fence until it finds an open gate, then go through. One of the things we were doing in another study was to experiment with different kinds of tortoise guards, similar to cattle guards. We wanted something that you could drive a vehicle over but a tortoise will not cross."

On With the Hunt

Now it was time to find more of last

Photo B. Special fences along highways in California's Mojave desert keep tortoises off the road, where death would be almost certain. The white PVC pipe marks part of the survey grid.

Photo C. Environmental consultants Glenn and Tracy Goodlett unlock the desert-proof vault containing a solar-powered tortoise crossing sensor.

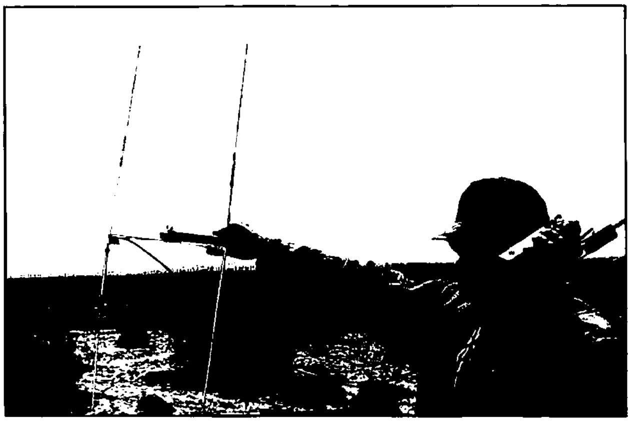


Photo D. Biologist Paul Frank shows that simple, rugged equipment is all that is needed for on-foot wildlife tracking. On windy days like this, he usually uses earphones.

Photo E. This desert tortoise doesn't mind being a perpetual hider for biological T-hunts, all for the sake of science and conservation.

year's tagged turtles. Each transmitter is on a different frequency in VHF "high band" between two meters and TV channel 7. A few commercial manufacturers offer portable synthesized receivers designed for researchers, but Glenn says he has results just as good with less expensive VHF scanners, so long as they include a BFO for SSB/CW detection. Scanners are much smaller and lighter than the special receivers, too. He likes being able to program his scanner such that channel numbers are the same as tortoise numbers, for fast identification of new intercepts.

Glenn uses a Trident TR2400, while Paul tracks with a Sony ICF-PRO80 (Photo D). Both use two-element phased dipole antennas by Telonics, Incorporated (932-T East Impala Avenue, Mesa, AZ 85204). We went to an area where several animals had been living and acquired three signals. I tried out the Sony setup and had so much fun that I didn't stop until I had found all three tortoises. Two were foraging and one was in its shallow burrow.

The phased array antenna has a classic cardioid (heart-shaped) directional pattern. When searching on foot for a tortoise in the open, maximum range is about 3/4 mile. I was surprised how sharp the forward lobe seemed on weak signals. A single 30 dB RF attenuator was all that was needed to knock down the signal as I got within 100 feet or so. No S-meter was needed; we determined signal level easily by ear.

Just as in ham T-hunting, I got incorrect bearings at some points in my pursuit. Perhaps the turtle's antenna orientation was putting a null in the direct signal path, or some object was reflecting the signal. Researchers know that if they keep moving and follow their bearings, they will follow a more-or-less direct path to the animal.

According to Glenn, "The hardest part of the hunt is getting to hear the signal. The rest is relatively easy. They tried triangulating with multiple fixed-site receivers, but the big problem was that not enough of the receivers could pick up the weak signals."

To acquire signals at greater range, Glenn's crew has a long yagi to mount on a mast at the rear of their truck. RDF with small aircraft is also done. "We use two directional antennas, attached to each wing strut, and a selector switch for left, right, or both," he says. "Typically we fly a pattern and we switch the antennas from left to right and back to zero in."

Approximately fifty tortoises have been tagged in this study. Three transmitter models are being used. They are a product of AVM Instrument Company (2356 Research Drive, Livermore, CA 94550), which makes tags for a wide variety of animals. Adult tortoises can easily carry a AA-size lithium battery, which is by far the largest and heaviest component in the tags used on them. At a peak power level of about 1 milliwatt, pulsed 70 times a minute, the tag of (Photo E) will stay on the air for up to two years. The entire T weighs 35 grams and is encapsulated with a desert-proof coating.

"I tried out the Sony setup and had so much fun that I didn't stop until I had found all three tortoises. Two were foraging and one was in its shallow burrow."

"Mercury batteries were the best choice in the past," says Glenn. "But they are now considered hazardous and are banned in California. When the battery dies we send the tag back, they put a new battery in and seal it up."

Glen continues. "We used to cement a metal plate on the tortoise shell and bolt the transmitter to the plate. Now we just mount it directly. We put down a dab of super glue to hold everything in place and fasten it down thoroughly with epoxy cement."

Epoxying an antenna to the tortose shell for its full length would interfere with the animal's growth. Instead, researchers glue sections of tubing to the center of the scutes (plates) on the carapace, with the antenna inside the tubing. As growth occurs between the scutes, the antenna slides within the tubing.

The smallest transmitter (not shown) has a tiny solar panel and is used on juveniles. 'They come out of the egg at about 45 millimeters long." Paul says. "The smallest tagged turtles are about 60 mm long. The transmitters don't seem to affect them. We haven't seen any evidence of health or behavioral changes due to the tags."

So far, the study has shown that tortoises are mostly stay-at-homes. According to Paul, "Males are more territorial than females. A young one can get beaten up by a big male, which freaks him out. He will then take off for many miles to find a new territory for himself." Tagged tortoises that leave the survey area continue to be monitored.

NBS hopes its study will show a reversal in the downward trend of the number of desert tortoises. "In the late eighties and early nineties the population crashed," says Paul. "In some areas 70 to 90 percent died. They live to be a hundred years old and take up to twenty years to become sexually active. So they can't reproduce their population any faster than humans can, maybe one percent rebuilding per year maximum."

Paul adds that the biggest predator threat is the raven, which attacks turtle eggs and young. "Raven population is increasing dramatically because of human activity. They are taking out a huge number of juveniles. Desert development, off-road vehicle use, and livestock raising all contribute to the threat."

Radio tags help researchers know the movement and health of animals, but thorough surveys are needed to accurately assess population levels. Glenn explains, "A team takes a square mile, puts it in the grid system and methodically searches each grid, walking back and forth through it about 8 meters apart. Typically these are called 60-day surveys, because you work 60 days and you go over each hundred grids in the square mile twice. This year we're doing a 60-day survey to make an updated estimate of population density. But we already have a good guess because we spend so much time out here."

All Creatures, Great and Small

T-hunting for tortoises in flat country is not too arduous. ("About KØOV's speed," according to the witty hams around here.) I'm sure adrenalin levels go up quite a bit when you're hunting something that moves a lot faster and might decide to hunt you instead. For instance, signals from radio collars are keeping researchers updated on the movements of cougars in the mountainous parts of Orange County, where I live. The big cats are creating controversy as housing areas and freeways push into their habitat and bound their hunting range.

Birds have their own set of tracking problems. They have good radio range when airborne, but migration can take them long distances. Transmitters must be very light and placed very carefully. Right now I am exchanging E-mail with a researcher who wants to discuss ideas for better bird tracking.

If you would like to read more about wildlife RDF, let me know. If there is enough interest, I'll have more on the subject in future installments of "Homing In." Keep your T-hunting news coming, too. Send E-mail via the Internet (HomingIn@aol.com) or CompuServe (75236,2165). Send postal mail to my P.O. box on the first page of this article.

Number 14 on your Feedback card

PACKET & COMPUTERS

Jeffrey Sloman N1EWO
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

A Brief Primer on Internet Access

Tuning into the Internet, I've gotten quite a response to my recent call for information about Internet providers. This includes both answers and questions. Based on the questions, I present this brief primer on Internet access.

What is the Internet?

The internet (note the big "I") is a conglomeration of networks and computers worldwide which are connected together using TCP/IP (Transmission Control Protocol/Internet Protocol). The reason I point out the big "I" in internet is that any connection that involves two or more networks can be legitimately referred to as an "internet." The "Internet," though, specifically refers to an internetwork developed by DARPA and educational/industry institutions for collaboration.

Today, the Internet is a collection of public and private resources available through ISPs (Internet Service Providers) to anyone with some money to spend—and lately not too much money at that. Note: there are also public access sites that charge no fee. These are usually run by universities or government agencies.

Why Should I Care?

At first, the Internet was the realm of academics and military personnel. It was esoteric and hard to find outside of the academic/military milieu. Because the Internet is now accessible by nearly any computer user, things are different. There are many useful information and communication services which use the Internet as a transport. These services have technical sounding names like Telnet and FTP, but by far the biggest "star" of today's Internet is the World Wide Web (WWW).

The "Web" is a user-friendly, flexible, graphical way to retrieve information. The client side of the Web consists of a web "browser." The browser is an application that understands how to connect to computers on the net that contain information formatted as "Web pages" and display them for you. A good browser can not only provide the pages, but access to other information services such as "gopher" and FTP (File Transfer Protocol). This means that the browser can be your principal connection to the net.

A typical session might be something like this: First you use the 'Web Crawler" search engine to locate a ham radio page. The Web Crawler displays a "form" to make the search. It is very simple to use; just type in keywords of interest ("ham radio") into the search box on the screen and press the Enter key.

Your query is sent to the search engine—located on a computer in the Computer Science department of the University of Washington, in Washington State. The search engine has a frequently updated index of the (literally) hundreds of thousands of documents. The results are compiled and then sent back to your browser.

Next to each document in the result is a score of up to 1000 to indicate how closely it answers your query. To look at a document you simply double-click on the document of interest. In our example there are many good looking results, and part of the list looks like this:

```
1000 The New Hampshire Amateur Radio Page
0976 http://ieeesb.eng.mcmaster.ca:70/0h/pages/ham.html
0896 Ham Radio Outlet has Moved
0863 Other QRZ Products
0754 http://www-bprc.mps.ohio-state.edu/cgi-bin/hpp?scanner.html
0704 The Los Alamos High School Ham Radio Club
0701 WHAT IS AMATEUR RADIO?
0692 AB4EL on ThePorch
0541 WB4EJC Home Page
0494 Amateur Radio WWW site of DK0TUI at Technical University of Ilmenau
0482 MegaNet Commercial Web Pages
0446 Other hyperlinks
0431 QRZ Home Page
0431 Bradley University Amateur Radio Club
0428 W5AC Home Page
```

Near the middle of the list is a document called "WHAT IS AMATEUR RADIO?"—let's try that one. The result in this case is a text document with no

graphics, though there could easily have been some. The beginning says:

WHAT IS AMATEUR RADIO?
A retired military officer in North Carolina makes friends over the radio with a ham in Lithuania. An Ohio teenager uses her computer to upload a chess move to an orbiting space satellite, where it's retrieved by a fellow chess enthusiast in Japan. An aircraft engineer in Florida participating in a "DX contest" swaps call signs with hams in 100 countries in a weekend. In California, volunteers save lives as part of their involvement in an emergency communications net. And at the scene of a traffic accident on a Chicago freeway, a ham calls for help by using a pocket-sized hand-held radio.

There are, of course, hundreds of megabytes of ham radio information out there of every description, from text files to programs of interest to hams—all a point and a click away. Vendors of ham radio equipment and software, hams with information about using equipment and building things, all of it right there for *you.*

How Do I Get Connected?

As it happens, now is a great time to get connected to the Internet. The competition is fierce, and prices are *very* low. But, you must know what you are buying or you could be very disappointed.

Watch out for "fake" Internet access. What do I mean? What I described above comes from actually connecting *your computer* to the Internet. In other words, through software and an ISP's "router" you place your own machine on the Internet as a peer (an equal to all the other computers on the net.)

When I say "fake," I mean that although you can access information that is on servers which are on the net, your connection is by dialing up someone else's machine and acting as a terminal. This is the nature of Internet connectivity offered by several large national on-line services. It is not what the true "netsurfer" wants.

"Real" Internet connectivity comes through a couple of protocols called SLIP and PPP. SLIP means Serial Link Internet Protocol, and PPP means Point-to-Point Protocol. They are functionally equivalent, with PPP being a bit more flexible. Either way, you'll be on the net.

What do I need?

The basic components of an Internet connection are a "stack" and the clients. The stack is the software that runs TCP/IP; included in this are the dialer and component that manages the SLIP or PPP connection. The most common stack in use today for SLIP is based on WinSock—the standard TCP/IP services component for Windows—but you don't need to worry about details, your ISP will do that for you.

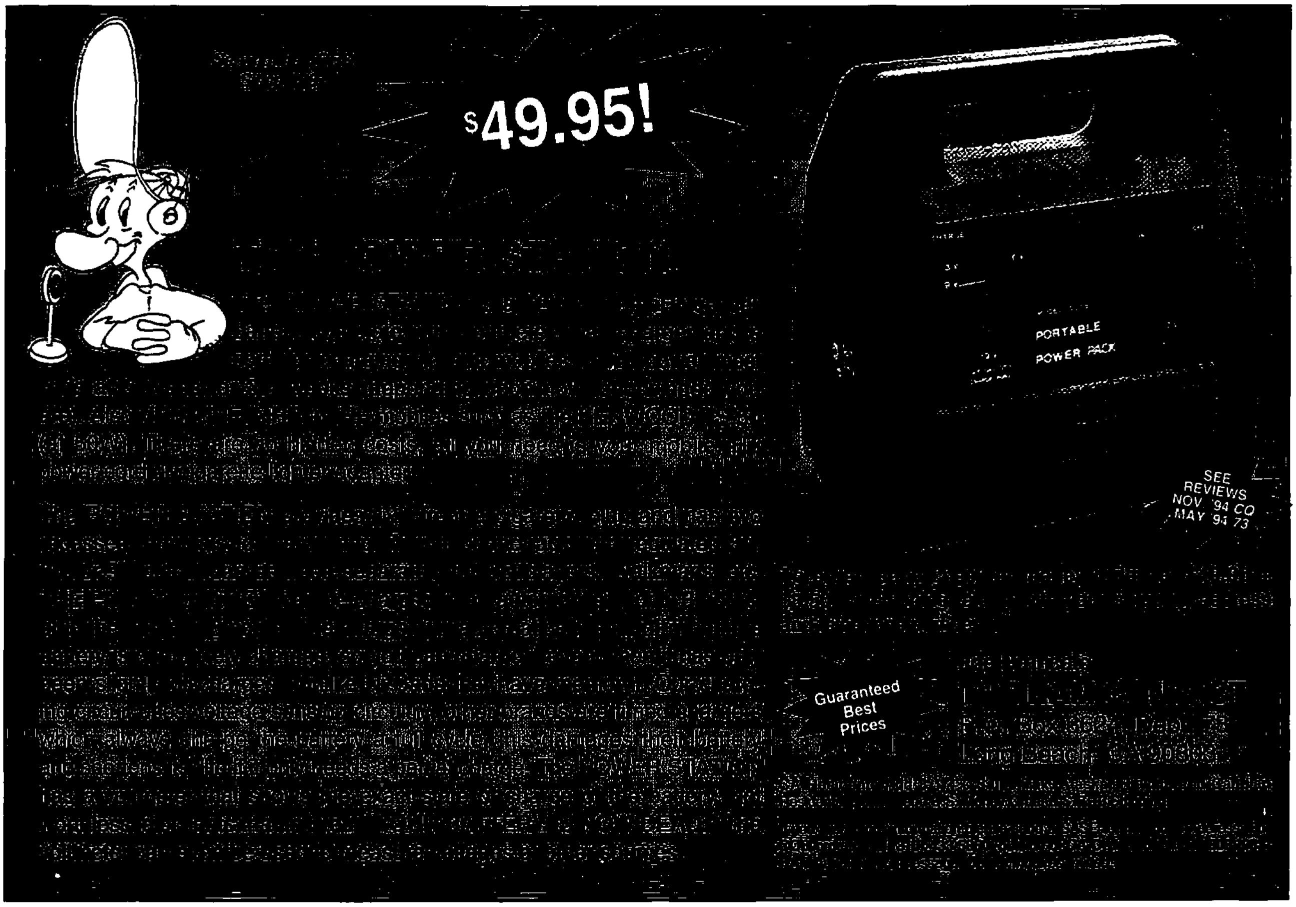
"There are hundreds of megabytes of ham radio information out there of every description, from text files to programs of interest to hams—all a point and a click away."

The thing you need most is a reliable ISP. Soon (probably next issue) there will be a list published here of ISPs recommended by your fellow hams. Until then, use the repeater! Ask around and find out who is doing a good job in your area. Prices will be very competitive; you shouldn't have to pay more than about $20.00/month for unlimited (or practically unlimited) SLIP/PPP access at 28.8 Kb/s access. Contact an ISP, and they will get you going.

Modems are Important

I will leave you with this note: A good modem is critical. Today, 28.8 (V.34) modems are common, inexpensive, and expected. If you have anything less than 14.4 today, upgrade *before* you sign up for Internet service. If you have a 14.4 modem, seriously consider 28.8! I can happily recommend the USR Robotics Sportster V.34 modem as an excellent value. It is an Inexpensive and high-quality, high-speed modem. Make sure you buy a V.34 modem, *not* a V.FC modem, which is an outdated "non-standard." Also, don't be disappointed if your 28.8 modem never connects faster than 24 Kb/s. This is normal, because phone lines aren't perfect.

So, after you begin your net surfing career, drop me a line at: n1ewo@iquest.net—I'll be glad to hear from you! 73 de N1EWO



ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

DRO Frequency Marker for 10 GHz From Salvaged C Band TVRO Converters

Here is a note of interest from John WA4WDL concerning the use of DROs (dielectric resonator oscillators) from defunct or discarded TVRO (television receive only) downconverters. These units are modified to provide a marker generator for the 10 GHz amateur band. Also, John provided a charge pump voltage doubler that he used to power these units from a 12-volt source. The application for this marker generator is to provide a stable frequency reference and to use this reference as a marker pinpointing a specific frequency in the wideband FM portion of the 10 GHz band, using it as a guidepost for all operations. Following are the conversion steps taken by John WA4WDL:

One of the first concerns when trying to operate on 10 GHz using wideband frequency modulation with modified intrusion alarm Gunn diode sources is determining what frequency you are on. Past remedies have centered around using a 2 meter HT feeding a diode-in-waveguide harmonic generator, which works like this: The HT is set to a frequency of 146 MHz and is used to transmit low power (100 to 250 mW), which is injected into a diode in a waveguide mount suitable for the microwave band of interest, in this case 10 GHz using WG-16. The diode is made to function as a frequency multiplier, multiplying the 2 meter RF into the 10 GHz band. The 70th harmonic times 146 MHz is exactly 10.220 MHz, a wideband FM primary frequency. Other 2 meter frequencies are possible but do not work out as exactly as in this example.

However, because of the relatively low frequency of the 2 meter rig and the lack of image rejection in the 10 GHz receiver, some confusion still exists in image frequencies and other harmonics of 146 MHz, also present. This method relies on you knowing what frequency you are on with an accuracy of plus or minus 50 MHz. If you have no clue where you are, a single pinpoint reference will remove uncertainty and provide you with one more idea on how to set frequency at 10 GHz with available surplus material.

Recently, while dissecting some C-band TVRO block downconverters, I discovered that the internal local DRO operates at approximately 5.150 GHz. Doubling this frequency with a diode-in-waveguide harmonic generator results in an output frequency of 10.3 GHz, which is conveniently in the 10 GHz amateur band. Don't let the quality of surplus block downconverters worry you. While the RF amplifier portion of the unit might be damaged or non functioning, the DRO circuitry needed for this conversion has rarely been inoperative. Almost all DROs still function well.

I have noticed that after doubling, all harmonics and the fundamental are at least 30 dB below the desired 10.3 GHz signal. The 10 GHz waveguide is an excellent beyond-cutoff attenuator for the fundamental, and the efficiency for tripling is very poor. Although DROs come in several configurations, two kinds are easy to use.

The first involves a block downconverter that was intended for use with a preamp (see Photo A). The RF input goes to a ring mixer which is also fed by the local oscillator. With some razor blade surgery the ring mixer is modified to let the local oscillator connect directly to the RF input connector. (See Figure 1 for details.)

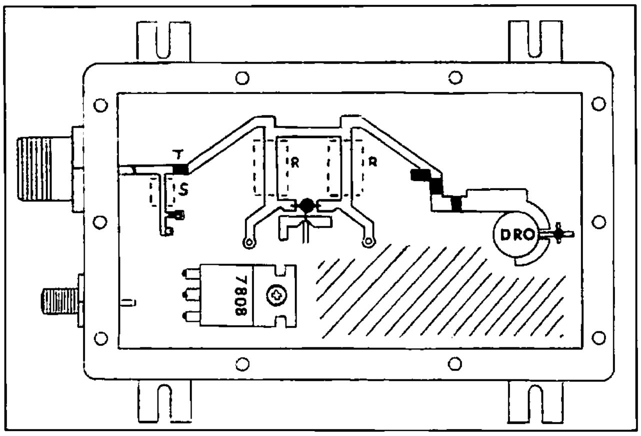


Figure 1. Modifications to downconverter printed circuit board.

The modifications to the ring mixer are marked "R." Some other modifications are necessary. DC power for the preamp is fed out the RF input connector. For my application this is undesirable because the 1N23 multiplier diode could be destroyed. Instead the DC insertion trace marked "S" is cut and carefully peeled up from the printed circuit board. The 1N23 point-contact diode multiplier requires a DC ground return. The local oscillator has a two resistor L-pad output attenuator which can be used for the DC return by simply replacing the chip capacitor at point "T" in the RF input line with a jumper made from copper foil.

The capacitor was originally used to block the output DC from reaching the mixer. Photo A shows both an unmodified and a modified downconverter. Each block downconverter has an internal 7808 three-terminal voltage regulator, which is retained. The units can be powered from 11 to 18 volts. DC power is applied directly to the IF output type "F" connector. Current drain can be reduced by cutting the appropriate printed circuit traces to circuitry that is not required. Output from the DRO is about 3/4 mW at 5.15 GHz, which is more than sufficient to drive a 1N23 diode harmonic generator.

The second block downconverter is with a packaged Murata DRO. (See Photo B.) Carefully unsolder and remove the oscillator unit, then mount and resolder it to a printed circuit board. Even though it is lossy at 5.15 GHz, ordinary G-10 1/16th-inch thick double-sided glass epoxy board material is used. It's workable and easily available. An SMA connector is used to couple the RF back from the printed circuit microstrip into a semi-rigid coax cable. (See Photo C.)

Typical RF output is between 3 and 5 milliwatts at 5.15 GHz. With 12 to 14 dB loss inherent in half-wave harmonic generators, I still get around 0.1 milliwatt output at 10.3 GHz—not bad at all. A complete unit with 1N23 diode harmonic generator is shown in Photo D.

This method does not require diode waveguide mounts without the bypass circuitry commonly found in simple diode mixer mounts. Nevertheless, the result is a no-tune, compact, reasonably stable marker or test source for the 10 GHz band.

In operation, the Murata DROs that John has encountered require 10 volts at 20 to 30 mA for power. It is always a good practice to power up the unmodified downconverter with 15-18 volts and measure the oscillator and

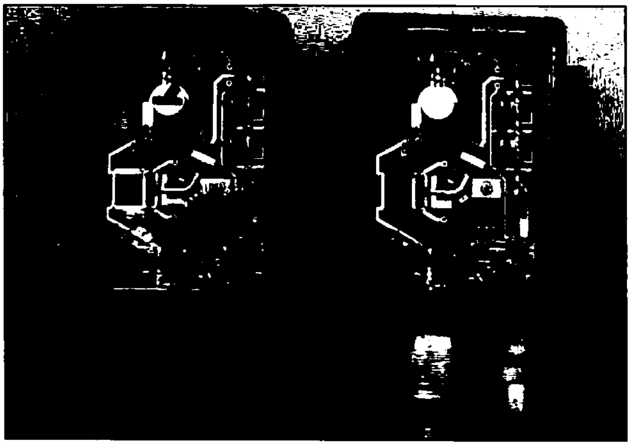


Photo A. TVRO downconverters requiring a preamp.

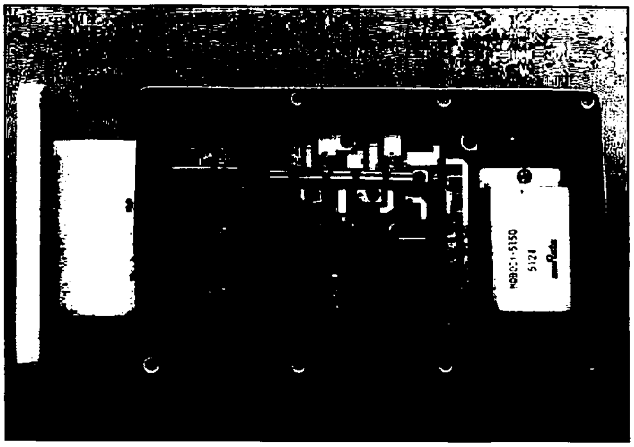


Photo B. Downconverter with a Murata DRO.

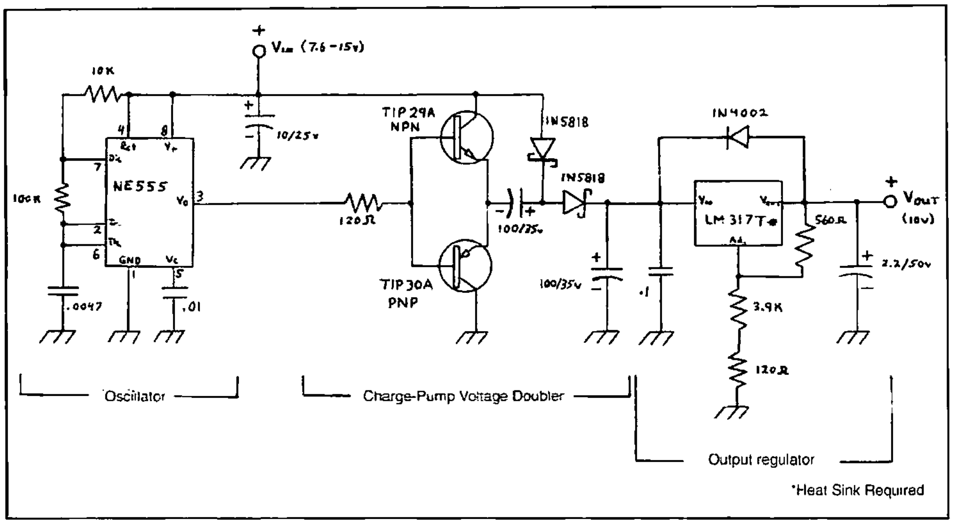


Figure 2. Schematic of charge pump voltage doubler with regulator.

the circuit supply voltages before beginning surgery. For field tests, better voltage headroom for the voltage regulator is desired. The difference between the required 10 volts and the output of a 12-volt dry cell battery is too small to use a common 7810 three-terminal voltage regulator removed from the downconverter, so a charge pump voltage doubler followed by a voltage regulator was selected for field applications. Figure 2 shows the schematic of the charge pump constructed.

The charge pump incorporates several small changes over previously published circuits. First, the NE-555 oscillator circuit was changed to produce a more nearly square wave output pulse duration. Second, the rectifier diodes were changed to Schottky rectifiers to reduce the voltage drop across the rectifiers. Schottky diodes have a lower voltage drop than conventional rectifier diodes; i.e., a 1N400X-type diode will exhibit a 0.7-volt drop when in conduction. A Schottky rectifier will exhibit about 0.4 volts in the same application. Last, the usual 240-ohm resistor used in most LM-317 adjustable voltage regulator circuits was increased to 560 ohms to reduce regulator current drain and increase battery life. Figure 3 shows the output voltage of the doubler before the regulator for input voltages up to 15 volts with no load and with the regulator and DRO connected. With no load and a supply voltage of 15 volts, the output from the doubler can reach

"When given the choice between increased current drain and no operation, I'll pick current drain every time.

29 volts; therefore the output capacitor should be rated for at least 35 volts. Photo E shows one of the voltage doublers mounted in a small shield box. The voltage regulator is mounted in close proximity to the DRO.

For some units the LM317 was replaced with a 7810 regulator salvaged from TVRO converters. Using the doubler with this regulator allowed operation with dry battery packs down to 7.8 volts, which is well beyond the useful life of a 12-volt dry cell battery. Even 9-volt dry cell batteries could be used. The main penalty in using this circuit is the increased current drain. When given the choice between increased current drain and no operation, I'll pick current drain every time.

I have to thank John for one more excellent idea for converting surplus material into useful microwave test generators. For comments, contact John M. Franke, 23 Parkwood Dr., Apt 201, Yorktown, VA 23693-4819. Thanks again, John, for an excellent conversion project.

Technical Note Update

Our microwave group just ran into a microwave transistor phenomenon that took us by surprise. It happened with a 1296 MHz block amplifier module that was built to spec, as far as we were concerned. It was supposed to put out 10 watts of power with a trickle of RF driving it. The problem was that the unit just did not perform at all, and power output was a small fraction of what it was supposed to be. After consulting with fellow wizards and the manufacturer's tech rep, we determined that the possible trouble was that we applied *heat sink compound* to the heat sink and RF device. As we all know, heat sink compound is used to improve heat transfer to the heat sink from the power or RF device.

We were informed that most microwave devices operating at 1000 MHz and above require such good ground that heat sink compound was not conductive enough for these microwave frequencies. We did not really believe this, but removed the grease anyway. When we tested the amplifier module without H/S compound, the module produced 10 watts of power with no other changes or modifications. Heat sink compound was the culprit. We had used the standard white silicon heat sink compound, which from now on I will classify as white heat sink *grease* suitable only for low frequency work.

There are several products that are made for UHF to microwave operation as heat sink compounds. These materials usually resemble an epoxy with very high silver or other metallic additive making the thermal properties very conductive. I haven't been able to obtain any of these materials for evaluation, but have observed some power FETs attached with this type of material. I had not fully appreciated the RF-conductive material before, but close examination of many different heat sinks removed from commercial devices showed most were using this RF-conductive heat sink thermal compound.

We had experienced a similar example when we tried to test a 10 GHz Qualcomm transmitter module by soldering the gold-plated transistor's heat sink to the rear copper ground foil for a quick test. This test proved to be flawed and the transmitter, which is rated at 1 W output, would not produce any significant output power at all. When we ran our finger near the

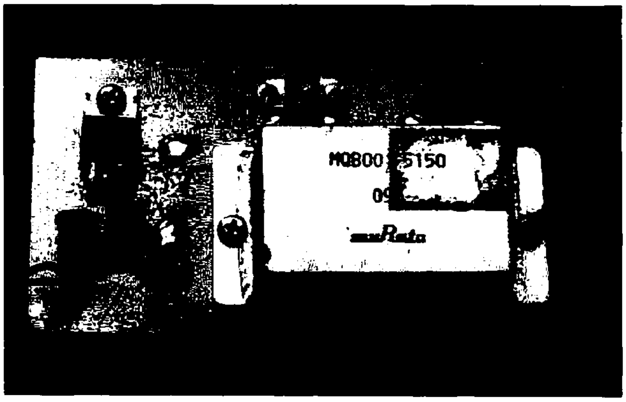


Photo C. Murata DRO remounted on a circuit board.

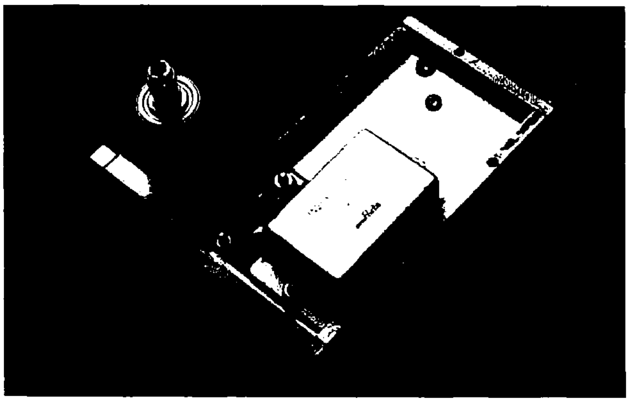


Photo D. Complete 10 GHz marker generator.

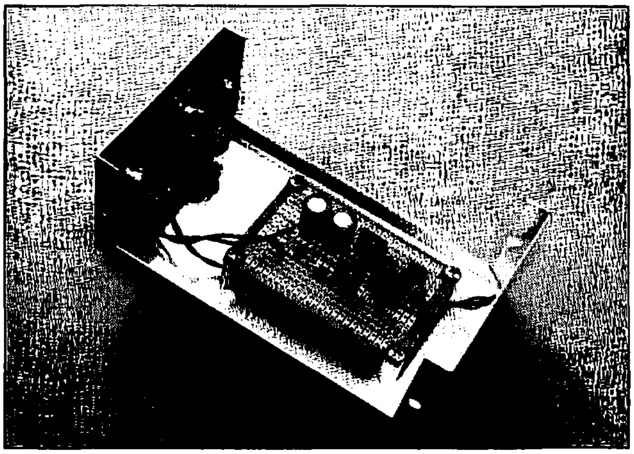


Photo E. Voltage doubler mounted in shielded box.

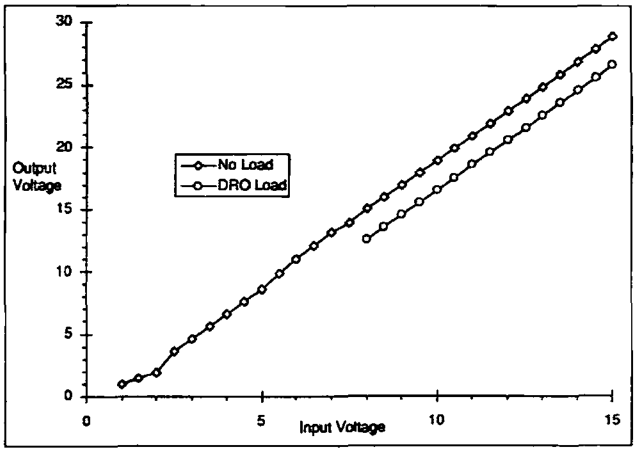


Figure 3. Charge pump doubler output for input voltages of 1-15 volts.

grounded side of the PC board under one of the transistor stages (soldered to ground), power output improved several dB, a very unusual increase in RF power. To get the transmitter back in operation, we had to remove the solder grounding all the transistors and screw the devices directly to an aluminum heat sink along with the PC board ground's common ground foil. Then the transmitter strip functioned normally, and shortly we were able to obtain the full 1-watt output power.

These two examples show the extreme importance of proper grounding in microwave devices. I would not have believed either of these two examples, and thought that in each case it was well within a small fudge factor acceptable to good construction techniques. However, both methods proved that the silicon heat sink grease we used gave very poor results. There might be similar material out there, but I'll report on that when such materials become available. Till then, if you experience weird results, question your heat sink compound and, hopefully, removing it will avoid some quite perplexing head-scratching.

Well, that's it for this month. Currently we are putting together a complete 10 GHz transceiver driven by synthesizer control (*73* magazine, June & July, 1994). So far, the circuitry for the transceiver is converting well from a miniature PC board for 14 GHz to 10 GHz operation. For surplus, check out your local cellular distributor for old, large 850 MHz cell telephones. They're a drug on the market, often in broken condition, or just large units which are priced very cheap or given away. Look into them for possible circuitry for the 900 MHz band.

In the cell phone I picked up for $4.00, I have a complete RF receive front end and two VCOs, one for 800 MHz and one for 900 MHz. These parts can be used on their own or an attempt can be made to convert portions of the cell phone. Check out this surplus opportunity locally.

As always, I will be glad to answer questions regarding this and other related amateur topics. For a prompt reply, please send a SASE. 73 Chuck WB6IGP

Number 16 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Some Miscellania About DC Power Supplies

Every few months I dip into the mail bag and try to answer some questions from readers. A fair amount of mail arrives, and I try to answer as much of it as possible. Unfortunately, that's not always possible, so please forgive me if you wrote and didn't get a response.

Voltage-Regulated Low-Voltage DC Power Supplies

Although most of my mail tends towards RF circuits, antennas, and the like, a substantial number of people over the last year or so have asked questions about low-voltage DC power supplies. I suspect the reason for this interest is that ham shacks and SWL listening posts today have a lot of store-bought and home-brew projects (yes, hams still build . . . the naysayers notwithstanding), gadgets, accessories, and assorted do-dads that all run on low-voltage, low-current DC power supplies. Furthermore, many (maybe most) of those items want to see regulated DC power, rather than simply rectified and filtered power.

The type of DC power supplies that are needed are typically 3 to 28 volts DC, with most of them being 5 VDC, 6 VDC, 9 VDC or 12 VDC. Current ratings range from 100 mA to 1000 mA (1 A), with only a few being higher (some 5-VDC circuits with a lot of older style TTL digital ICs might want to see 3 to 5 amperes of current, and some 12-VDC units intended for in-the-shack operation of small 2 meter or higher handhelds or mobile rigs want to see similar current ratings). For the most part, however, we need 1000-mA or less DC supplies for add-on outboard do-dads; this discussion is limited to that range.

Rectifiers and Transformers

The raw AC power right off the line isn't useful for electronic circuits, no matter what the voltage is. The DC power supply will use a transformer to reduce the voltage to the range needed by the circuit, and then a rectifier to convert the bidirectional "sorta-sinewave" AC to pulsating DC. When filtered, this pulsating DC makes a reasonable version of DC electrical power and can be used for many electronic circuits.

Two forms of rectifier circuit are shown in Figure 1. The circuit in Figure 1A is the classical full-wave rectifier. It requires a transformer with a center-tapped secondary winding. The center tap is connected to the chassis ground (or common line when no chassis ground is used), and is the zero-volts reference point. The outer ends of the winding ("A" and "B") are connected to the anode ends of the rectifier diodes (D1 and D2). The cathode ends of the rectifier diodes are connected to the load (represented by resistor R1).

The rectifier diodes have two ratings: forward current and peak inverse voltage (PIV). The forward current rating must be at least the same as the maximum output current of the power supply, and a 20- to 40-percent over-rating would be a nice safety factor. The peak inverse voltage rating should be at least 2.83 times the RMS value of the secondary winding voltage (i.e., the voltage from the center tap to either end). For most low-voltage applications, using a 100-volt PIV (or higher) rectifier diode will suffice. Most people just go ahead and use the 1,000-volt PIV units, such as the 1N4007.

A filter capacitor C1 is used to smooth out the voltage pulsations of the rectifier output. A good rule of thumb is to use about 3,000 µF/ampere for unregulated DC power supplies. The actual value depends on the ripple factor desired, but the rule of thumb serves for most people's needs.

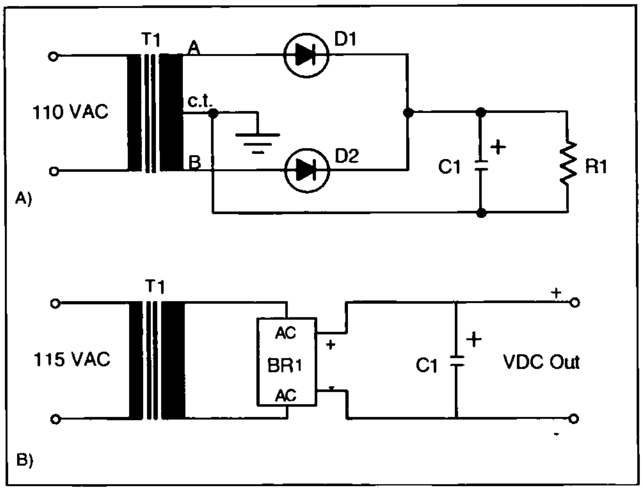


Figure 1. A) Classical rectifier circuit; B) bridge rectifier.

The rectifier in Figure 1B uses a full-wave bridge stack (BR1). Although you can make a bridge rectifier with four single diodes (e.g., 1N4007), bridge stacks are easily available in a number of different package styles. The AC inputs will be marked with the letters "AC" or the sine symbol "~." The positive output is marked with a "+" symbol, and the negative with the "-" symbol. One common form of package that is popular today is the DIP package that looks like a four-pin DIP integrated circuit package and fits onto 0.100 x 0.100 perforated wiring board.

The transformer does not use a center tap, because the common terminal is established by the bridge network inside BR1. A center-tapped transformer can be used, but some caution is needed. The current rating of the transformer is based on the classical full-wave circuit shown in Figure 1A, and not the bridge rectifier in Figure 1B. If a bridge circuit is used, then the transformer may have to be derated by one-half. In other words, if you need a 1-ampere power supply, then a 2-ampere center-tapped transformer is needed. If the transformer is intended for bridge service (and has no center tap), then a 1-ampere transformer would be needed. You can often get away with not derating, but only for short duty cycle operation. You may literally be "playing with fire" if you run the transformer too close to its apparent maximum rating.

Voltage Regulators

Most projects today need regulated DC power. These circuits keep the output voltage stable despite changes in load current demand or changes in the applied AC voltage. Normal power line voltage fluctuates from 105 to 125 volts RMS quite normally, and during summer "brown-out" conditions it might droop below 100 volts RMS. This is a 9- to 10-percent fluctuation (some experts say that 15-percent fluctuations are not as rare as you might think).

Another advantage of the voltage regulator is that it reduces the ripple considerably. I recall a salesman who came by a shop I worked in (early 1960s) and told us he had a DC power supply that would power CB radios and car radios, and had "the equivalent of one farad of ripple filtering." What he was telling us was that Delco Electronics had used electronic voltage regulation in their P-612 power supply, and the voltage regulator smashed the ripple down as much as a 1,000,000 µF filter capacitor! That power supply was a "first" for us, but today such power supplies are commonplace.

Fortunately, today we can buy three-terminal IC voltage regulators that provide a fixed (standard) voltage, and have current ratings of 100 mA, 750 mA or 1,000 mA, depending on the type. Figure 2 shows a typical circuit using these regulator devices (U1

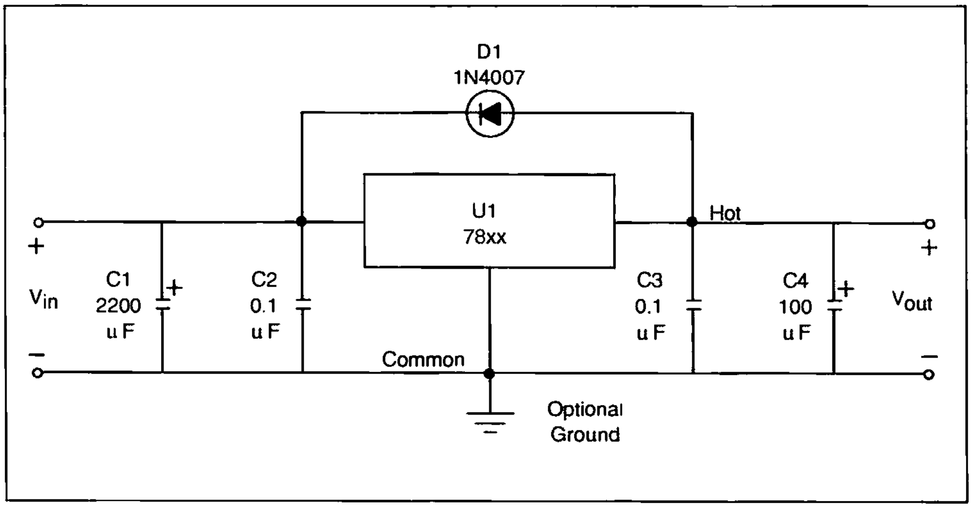


Figure 2. Voltage regulator using a three-terminal IC voltage regulator.

is the regulator).

Two different types of part number are seen on the regulators. If the device is of the LM-340 series, then the form of the type number is "LM-340n-xx." The "xx" indicates the voltage rating. If it is "05" or "5," then the device is a 5 VDC unit; if xx is "12," it is a 12-volt regulator. The "n" may or may not be seen, and indicates the package type (which also tells us the current rating). A "K" indicates a TO-3 diamond-shaped power transistor style of package, while a "T" indicates the TO-220 plastic package device. Thus, an "LM-340K-12" is a 12-volt regulator with a TO-3 package (which means that it is probably a 1-ampere device). TO-220 devices are typically rated conservatively at 750 mA in free air, or 1,000 mA if heat-sinked.

Regulators of this type with negative output voltage are marked "LM-320n-xx." There are pin-out differences between the LM-320 and LM-340 devices, so look it up before using the regulator.

The alternate marking scheme is "78xx," in which the "xx" indicates the voltage output rating. The 7805, therefore, is a 5 VDC device, and the 7812 is a 12-volt device. The negative output voltage versions are "79xx" (and again, pin-out differences exist).

Small packages, such as the TO-92 plastic transistor package, are rated at 100 mA. These devices are often marked with type numbers that have an "L" (for "low power") in the part number. Thus, a "78L05" is a 5 VDC output regulator with a TO-92 plastic package and a 100-mA current rating.

Capacitors C2 and C3 are used to keep noise from affecting the operation of the voltage regulator. These 0.1- to 0.47-µF capacitors are to be mounted as close to the body of the regulator (U1) as physically possible.

Capacitor C1 is the ripple filter, and should have a minimum value of 1,000 µF/ampere (some say 2,000 µF/ampere). For the typical 1-ampere power supply, I prefer to use a 2,000 µF/50 WVDC unit. Note that C1 is marked with polarity. These capacitors must be installed correctly, or may blow up!

The output capacitor C4 is used to smooth variations caused by sudden shifts in load current. It has a rating of 100 µF/ampere. If C4 is used, then diode D1 should also be used. This diode is reverse biased during operation, but when the power is turned off it will become forward biased any time the voltage across C4 is greater than the voltage across C1. This keeps the charge in C4 from damaging the substrate layer inside U1.

Next Month . . .

Next month, we will finish this topic, and look at a variable output voltage regulator and some switching schemes for DC power supplies.

ATV

Number 17 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

LISATS

There is a very active ATV group near the Kennedy Space Center called LISATS (Launch Information Service & Amateur Television System, Inc.). Due to their close proximity to the space center, the LISATS group wanted their ATV repeater (with the very appropriate callsign K4ATV) to feature continuous coverage of the NASA Select video feed during each Space Shuttle mission. Located at a commercial radio station's studio site (WLRQ) in Cocoa, Florida, the K4ATV repeater operates with an input on 434.00 MHz and an output on 421.25 MHz.

There are around two dozen ATV stations in the area that can access the ATV repeater. Since the output can be tuned in via a cable-ready VCR or TV (cable channel 57), the LISATS group has a wide audience throughout central Brevard County. Since their antenna is located at the 235-foot level of the WLRQ tower, the K4ATV machine can be seen over 30 miles away under normal conditions. A number of schools have receivers in their classrooms that can tune in the Space Shuttle coverage. The LISATS group also provides the NASA Public Affairs Office with handouts and information about their system that is given to the press during every Shuttle mission. Since the repeater is near the Shuttle launch area, a snow-free picture can be tuned in with a small portable TV for those observing the launch from the various launch viewing areas. It's great to see live NASA coverage while actually watching the Shuttle lake off.

The K4ATV Repeater

The receive antenna is a Hustler 10 dBd vertical collinear located 400 feet up on the tower (see Figure 1 for a diagram of the K4ATV LISATS system). After going through a VSB filter, lhe video and audio are demodulated with a P.C. Electronics ATVR-4 receiver. All video and audio switching and ID timing are controlled by a Micro Computer Concepts VS-100 ATV repeater controller. Using DTMF tones on either 70 cm or 2 meter FM, this controller can switch up to 10 video and 4 audio sources. Currently, the repeater can be controlled to retransmit the received video from 434.00 MHz, NASA Select (as received by a Panasonic 1000 TVRO system), the LISATS logo (VDG-1 video identifier) or a computer-controlled bulletin board system. The bulletin board screens come from the output of a Commodore 64 running the Engineering Consulting Video Poster™. A non-volatile RAM cartridge can be loaded with up to 26 scrolling (or flashing) messages that sequence announcements of current amateur radio news and information, including a daily updated list of planned NASA launches and color test patterns on-screen via lhe repeater. The messages can be uploaded easily from one of the control operators from their homes (K4RBD or N4KCI) via a 1200 bps telephone modem. In addition, they plan to install a tower camera to aid in Skywarn observations.

The transmitter system consists of an ATV Electronics 5-watt exciter driving a D-100ATVR repeater amplilier. After passing through an International Crystal VSB filter (ICM-407), the signal is fed up 7/8" hardline to a 10 dBd gain Sinclair vertical collinear at 235 feet. The LISATS system in its current configuration was assembled by John Anderson K4GCC, Ernie Baldini K4RBD, Bud Checkett WØTPB and Dave Glenn KD4SFR with much financial support from Gordon Seaward KA4FFA.

Tune into the Action

If you are in the central Brevard County area and would like to tune in the activity, you can see the repeater ID for 20 seconds on 421.25 MHz (cable-ready channel 57) every 10 minutes. In addition, the repeater retransmits NASA Select continuously during each mission. Recently, lhe FCC and NASA have authorized retransmission of other published expendable vehicle launches, so you may not have to wait for a Shuttle flight to tune in the action on the LISATS repeater.

There is a weekly activity night every Wednesday evening at 19:45 (7:45 p.m.) ET. Although lhe usual ATV talk-frequency is 144.34 MHz, during the activity night the group uses the K4GCC 146.94 (-600) repeater, famous for countdown coverage all over the Cape area. This machine is a great place to meet the locals just about any time during the rest of lhe week as well. You never know who might show up on this machine. One night Ernie K4RBD started up a conversation with WA4SIR. It turned out to be Mission Specialist Ron Parise, who had a quick chance lo make a

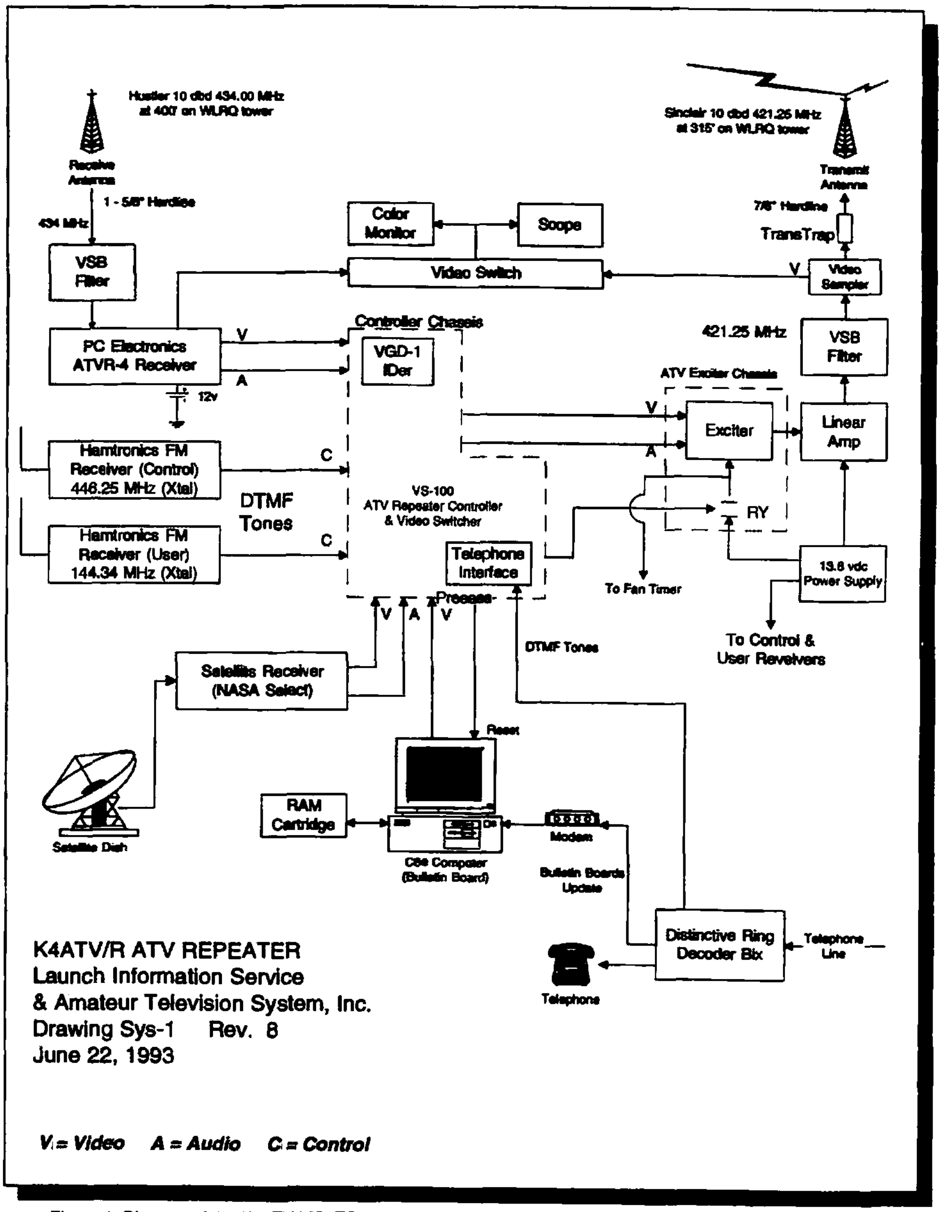


Figure 1. Diagram of the K4ATV LISATS repeater system in Cocoa, Florida. (Drawn by Mike Hadley KC4TCV.)

QSO just before he suited up to head out to the launch pad!

In addition to NASA coverage, the Brevard County EOC (Emergency Operations Center in Rockledge, Florida) has an ATV station that can be used through the repeater. The LISATS group has also successfully demonstrated the usefulness of ATV for emergency preparedness. They have participated in Red Cross simulated disaster drills, with several of the members transmitting pictures from mobile stations back to the command center. Another project in the works is a backpack 1200 MHz ATV unit.

If you'd like to find out more about the LISATS group (members receive a very informative newsletter), you can write to: Ernest Baldini, 453 Watts Way, Cocoa Beach FL 32931. Ernie's E-mail address is ebaldini@ddi.digital.net or ernestb l @aol.com.

For those of you on the World Wide Web on the Internet, you can browse through the LISATS information page. To access this screen, log on to www.digital.net. Once in the Florida On-line home page, look under Local Ham Radio clubs and then click on the entry that reads Launch Information Service & Amateur Television System, Inc. *Thanks to Ernie K4RBD for the above information.* 73

"It turned out to be Mission Specialist Ron Parise, who had a quick chance to make a QSO just before he suited up to head out to the launch pad!"

Number 18 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21200

By all accounts, one of the most popular versions of this column is the one which you all help write. The questions you all pose are often the launching sites for some of the more fascinating topics covered in "RTTY Loop." So, to start off the nineteenth year of this column, let's turn to the mailbag.

Glenn Inman VE6INM of Sherwood Park, AB, Canada, sends along a question as to whether or not I am aware of a scheme to use the Radio Shack Color Computer for packet or RTTY without any TNC. He would like to dedicate a unit to just these modes. With three CoCos kicking around, Glenn thought he may be able to use software rather than buy a multimode TNC. Well, I did look into the packet question a few years back, and was rather disappointed. It seems that while the 6809 CPU of the Color Computer is not unable to do the work, the CoCo itself may well not be up to the task. However, RTTY is a different story.

Several years ago, a routine was published here in "RTTY Loop" that can accomplish RTTY sending and receiving with only a simple interface for the audio-to-digital conversion. The quickest way to obtain the software is on the CoCo SIG on Delphi. Search the telecommunications library for "RTTY," and you will see several programs for RTTY on the CoCo. Good luck, and let me hear from you. Vern Modeland WAØJOG drops a CompuServe E-mail relating that:

Simple Programs Plus Hardware

"As an old broadcast newsman who started more than 4,000 days harvesting and devouring the output of a bank of teletypes, I've reluctantly had to give away my Model 15, then turn down the gift of a complete Model 15 Send-Receive setup with reperf, due to lack of space in retirement. It leaves me with only this Tandy 1000 TL/2 with 2-meg hard drive, and my HF and VHF Kenwoods with which to transition into RTTY in the computer age. I've read the ads closely, learning not enough, and articles, but still have questions. And there is no one close to this location on whom I can count for technical counsel as to the available programs, or programs-plus-hardware, that'll put me back on RTTY simply and without a lot of unnecessarily expensive bells and whistles. I'd welcome any thoughts, suggestions, or direction you might offer."

Well, Vern, you have two ways to go. If you want to play around with a solution low on cost but a bit more time intensive, you can try some of the programs that will run RTTY and other digital modes on a computer without a hardware terminal unit. A look at the programs in the "RTTY Loop" Software Collection will turn up many such programs. Alternatively, you can use the computer just as a terminal, and count on a hardware terminal unit to do the hard work. While this may cost a tad more up front, you may be rewarded with a quicker path onto the air, and a flexible on-the-air setup.

Whichever way you choose, you have the nucleus of a capable digital station. Let me hear from you with the story of your next steps.

A problem of a different sort is presented by Wayne WB4OGM. He is looking for sources for information on suppressing computer-generated RFI for HF radios. He was working on getting back into RTTY and was trying to quiet a PC XT with mono monitor using a HAL ST-6 TU. He had the PC pretty quiet, but the monitor generates a lot of noise, apparently through its cabinet, because chokes on the power and data cables didn't seem to help.

Well, Wayne, I agree that the plastic cabinets of earlier monitors present a problem. Other than switching to a more modern monitor, one which limits external emissions, I have no good way to eliminate RFI from such devices. Putting chokes on all external leads is usually helpful, but sometimes even they won't help.

Larry Antonuk WB9RRT of Marlborough, NH, writes:

HAL

"I'm a now-and-again RTTY fan, with my PK-232, but my biggest fault was getting a fellow ham hooked. The problem is, he keeps asking me all these questions, as if I know what I'm talking about. He's been using an MFJ-1224 with a CoCo and is happy with it. Unfortunately, at the last hamfest he bought a HAL ST-5000 ($50). Once he brought it over and we checked it out and found out it was only a demodulator, he was less than thrilled. However, the great name of 'HAL' still made us press on. At present, we know that (1) it's just the demodulator; (2) it only puts out 20 mA loop signals, not TTL or RS-232 levels; and (3) I have a 20 mA to RS-232 converter from something else he could use, but this would still give us Baudot, rather than ASCII, to his IBM PC. We would like to get the HAL going on his PC, but maybe for the wrong reasons . . . .

QUESTION 1. "Is the HAL going to be a better performer than the 1224? This was our initial thought, until we realized that the HAL was ten years older than the MFJ. Neither schematic looks that much more intense in the audio filtering circuits, etc. Should we just put the HAL on the rig for looks, and use the 1224 instead?

QUESTION 2. "If we should pursue the HAL, do you know of any Baudot to ASCII gizmos or programs that are appropriate? I have access to any of your articles over at Peterborough (and in the basement) if any come to mind.

QUESTION 3. "Can you recommend a good PC-based RTTY program? I currently use Procomm, which is a pain. The macros are too small, the chat mode won't work with my PK-232, etc., etc. Cheap is good, free is even better! Probably the listing of programs, etc., you mention would be a good start. Thanks for your help, and for all your columns over the years. (I know you sure can't be doing it for the money!)"

Now here is a set of questions I can sink my teeth into! First off, please don't be disappointed that the ST-5000 is "only" a demodulator. Such a demodulator did quite well for many years of hams until the current crop of smart boxes hit the scene. As I mentioned above, I am not aware of packet software for the CoCo, but the RTTY software mentioned above should work just fine with the CoCo and ST-5000. Alternatively, using the ST-5000 with a PC and several of the software packages in the "RTTY Loop" Software Collection should work just fine. Procomm is just an ASCII-type communications program, not a RTTY or packet program. Check out software written for amateur applications. I think you will be a bit happier. Well, having mentioned the "RTTY Loop" Software Collection a few times, you all can presume it remains available, now numbering more than ten disks. Send me a self-addressed, stamped envelope, or a piece of E-mail on any of the services below, for details. Comments, questions, or suggestions are welcome as well; send them to me at the above address by "snail mail," or electronically on CompuServe at 75036,2501, Delphi at MarcWA3AJR, America Online at MarcWA3AJR, or via Internet at MarcWA3AJR@aol.com.

HAMSATS

Number 19 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Then

When I first saw the cover of the August 1973 issue of *QST*, I didn't give it a second thought. Some guy was pouring something out of a paper cup into what looked like a circuit board in a wooden box. I was more interested in the construction articles and the advertisements. Later, when I had finished pulling a parts list together for the QRP transceiver, and had thoroughly investigated the articles on the new Hallicrafters and Heath rigs, I went back for another look. The cover caption read, "W3ZKI is shown 'potting' the OSCAR 6 repeater prior to launch." Questions came to mind. What kind of repeater needs to be potted? What was an "OSCAR?" How would it be launched? If this was some kind of equipment to be sent into space, why wasn't it being done by white-coat technicians in a clean room in a large government or industrial installation? I was about to get my first introduction to the amateur-radio satellites. The article assumed I was already up to speed with ham satellites. Part one of "The Sixth Amateur Satellite—A Technical Report" had apparently come out in July. Photos, block diagrams, schematics, drawings and a lot of text, put together by Jan King W3GEY, brought this curious self-contained, repeater-in-the-sky into perspective. Amidst the technical jargon that might look more at home in technical journals, were captivating bits of information that gave the reader a sense of "home-brew" and "built in the garage." In addition to the fact that wooden molds were used to contain the various circuits and potting compound, the 10 meter dipole for the downlink signals ". . . was constructed from standard 1/2" measuring tape . . ." Donations of parts and services for the satellite came from many well-known sources, including NASA, RCA, J. W. Miller, National Semiconductor, and others, but the builders were hams. Armed with a defined goal, well organized plans, and resources, components of OSCAR-6 were built by skilled enthusiasts all around the country. It worked. The satellite was expected to last a year after launch, but it didn't. It gave several years of service, thanks to the passionate efforts of the designers, builders, and those that monitored the satellite's vital signs and controlled it during its life in orbit.

Now

Times have changed. Thanks to the efforts of those that put together the hamsats of the past, the current major project, Phase-3-D, is a marvel of radio and computer devices big enough to carry many iterations of OSCAR-6 as small subassemblies mounted around the periphery of the seven-foot diameter spaceframe. When I visited the AMSAT construction facility in Orlando, Florida, I had to wear a white coat and white shoe covers when entering the clean room. Phase-3-D is big, really big. The computers and radio gear are only a part of the spacecraft. It has its own rocket motor and propellant tanks to boost it to the final elliptical orbit after the Ariane 5 vehicle takes the satellite to a transfer orbit. Banks of solar panels give the satellite a wingspan of over twenty feet and will provide power for many years to keep the onboard systems running. Antennas covering many VHF, UHF, and microwave ham bands will literally bristle from the structure. Phase-3-D has a commonality with its predecessors. The components and the work to put it all together come from the efforts of hams. Assemblies for the satellite are being built in university labs, industrial facilities, ham shacks of various satellite builders, and even garages.

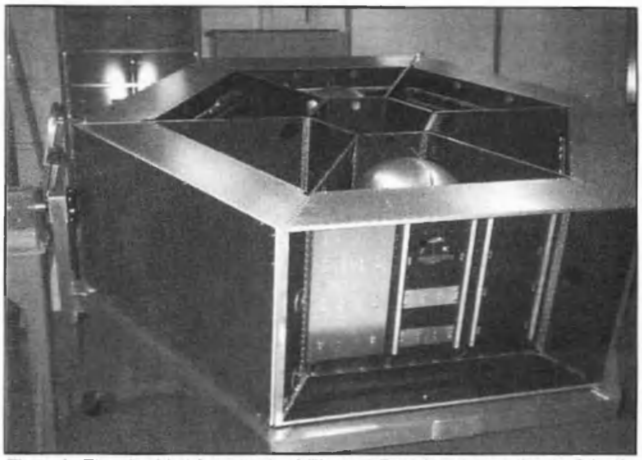


Photo A. The six-sided framework of Phase-3-D under construction in Orlando, Florida.

The Houston Connection

Prior to his retirement from NASA, Lou McFadin W5DID, Principal Investigator for SAREX (the Shuttle Amateur Radio Experiment) volunteered to fabricate various parts for Phase-3-D under the direction of AMSAT Vice President of Engineering, Dick Jansson WD4FAB. Lou converted metric dimensions on drawings to English units and got several small, curious, aluminum spacecraft pieces built. The pieces were then "alodined" on a workbench in the driveway at Lou's house. Lou also offered to wind the magnetorquer coils for Phase-3-D. Photo A shows the space frame in the Orlando clean room. The coils will be mounted around the six-sided circumference of the top and bottom faces. The coils are then connected to the onboard computer responsible for spacecraft orientation. In order to keep the solar panels perpendicular to the light from the sun, and the antennas aimed at the earth, the alignment of the satellite must be actively controlled. Pulsing a current through the coils in a specific sequence, when the satellite is at its closest approach to earth, provides a calculated directional twist or torque against the earth's magnetic field. This rotates the spacecraft to achieve the desired orientation. Photo B shows the location of the twelve magnetorquer coils on a working model in the Orlando lab. Applying power makes the model twist and rotate when suspended and allowed to interact with the earth's magnetic field. The flight coils for the satellite consist of 6,000 turns of special enamel-coated copper wire over an insulating tape layer on iron rods. Each coil has two sections of windings separated by a machined insulator at the center. Three layers of 1,000 turns each are carefully wound on each side of the insulator. To wind the coils, several items were required, including a tape spooler, a take-up system to turn and support the rod, a turns counter, a feed system with a constant-tension brake, and heat lamps to cure the epoxy coating on the finished coils. While Lou provided many items from his garage, members of the South Texas Balloon Launch Team put together an electronic turns counter and motor speed control for the take-up system. Other hams from the Clear Lake Amateur Radio Club and the Johnson Space Center Amateur Radio Club got involved with the tedious winding process and the epoxy-coating operation. The coil-winding project took about two months and was reminiscent of the scene from the cover of *QST* twenty-two years ago. Sophisticated pieces of space hardware were being built by hams to tight tolerances and precise specifications in somewhat questionable surroundings. The finished coils were packaged and sent to the AMSAT lab for final assembly. Lou W5DID has accepted the job of Phase-3-D Integration Facility Manager. Most of his "retirement" is now spent working on Phase-3-D, bringing together the pieces from groups around the world. Launch is expected next year, but there is a lot left to do. The AMSAT lab in Orlando will be open for tours during the 1995 AMSAT Space Symposium and General Meeting in October. The event will be held at the Airport Holiday Inn. Keep an eye out for the magnetorquer rods in Phase-3-D when you are at the lab, but don't expect to see "Made in Texas" etched on them. It wasn't in the specs. 73

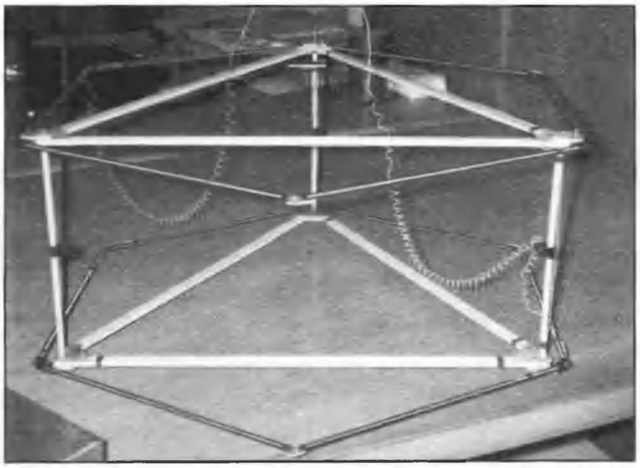


Photo B. A functional model of the magnetorqueing system for Phase-3-D

Photo C. Lou McFadin W5DID and the tape spooler used to cover the iron torque rods prior to the coil-winding process

Number 20 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Measuring Up

Last time, we were looking at the process of taking measurements in electronic circuits. Let's continue:

When we left off, we were looking at using an oscilloscope to measure the output of a power supply. Why do that when you can just hook a voltmeter up to the thing and be done with it? Well, it depends on what you need to know. Specifically, the scope will show you instantaneous changes in the supply's output that you just can't see with a meter.

Let's look at a plausible repair scenario. Let's say you have an older solid-state HF rig with an odd problem. This particular radio seems to basically work, but, when you transmit, the frequency pulls up and down a little bit on voice peaks, causing an FM effect that's distorting your voice and annoying other hams. So, you dig out the old meter and start probing away around the area of the VFO, which is an analog, non-synthesized one in this rig. After a few frustrating hours of fruitlessly going around in circles, you come to the altogether reasonable conclusion that the radio is possessed by demons. Or, perhaps, you're looking in the wrong place.

Steady As She Goes

Pursuing the latter possibility, what else could it be? You know a VFO needs a stable source of power, but you already put the meter on the B+ line and it showed approximately the voltage that should be there. So, no problem there, right? Whoa, wait a minute! Yes, the power supply may be giving you the right voltage, but does it stay there when the supply is stressed under the load of the transmitter? OK, you fire the rig up, into your dummy load of course, and check that voltage again, this time with your new digital voltmeter. It still looks all right, so it must be some other problem. If that's as far as you go, you're not going far enough, and you can just about count on another series of frustrating evenings at the bench. What you really need to know is what that voltage looks like at the instant your voice peaks come along. Does it wobble? If so, how much?

Zap, There It Is!

Now you get out your scope and take a look. You set the scope up to measure the 13 volts that should be there. It looks good, and, when you talk, it still looks good. Hmmm, wait a minute. To keep the 13 volts DC on the screen, you set the scope for DC coupling and 2 volts per division. Makes sense, but such a setup will make 200-mV wobbles look pretty darned tiny. In fact, you may not see them at all. Here's another way: set the scope for *AC* coupling and turn the sensitivity up to 100 mV per division. Now, the 13 volts will be blocked, and only the *changes* will show up. Son of a gun, there it is—voice peaks are causing a 200-mV change, all right. Is that OK? Maybe, maybe not. Most likely, it's not out of spec; even a well-regulated supply could be allowed to change that much as the load suddenly demands 20 amps of current. Still, we're on to something. The next thing to do is to check the VFO's internal regulator. Chances are, you'll find it shorted, or with an open zener diode, or otherwise unable to regulate the incoming changes in voltage, thus allowing the VFO's frequency to wobble along with the normal power supply variations. And, there's your answer. As you can see, the way you choose to use your measuring instruments can have a big effect on your success rate in fixing or building circuits.

> **"... keep in mind that your measuring instrument, be it analog or digital voltmeter, or scope, can and will rectify enough of a transmitter's RF to confuse itself. I've seen it happen with half a watt from an HT."**

Current

Can you measure current with a scope? Not directly. The only way to do it is to measure the voltage across a known resistance and calculate the current from there, using good ol' Ohm's Law. It sounds a lot harder than using a meter but, actually, that's how meters do it, too! The only difference is that now you have to do your own calculation.

The advantage of measuring current with a scope is the same one regarding voltage measurements: you can see what's going on in real time. Most of the time, you can infer what you need from voltage measurements and won't need to measure current with your scope. Now and then, though, especially in power amplifiers, it's very handy.

If the circuit under test has a handy resistor, such as a power amp's emitter resistor, you can simply measure the voltage across it and whip out the old calculator.

Pow!

Before you go actually hooking anything up, remember this very important fact: your scope's ground clip is actually connected to ground! So, if your circuit's ground is also really grounded, as many AC-operated circuits' grounds are (regardless of whether or not they have a third prong on the plug), you can't simply put the scope's ground anywhere you want, or you'll cause a short to ground and probably do some real damage. In that case, you're limited to measuring across something which has one end at ground anyway. More often than not, that's *not* going to be a point in the circuit which is useful to you. Probably the most useful current measurement is of power supply current feeding the circuit, and neither end of the B+ line is going directly to ground. The only way you can measure that with a scope is to uncouple either the scope or the circuit from ground. Is it worth all the trouble? Only if you really need to see the current in real time; otherwise, I'd just go with the battery-operated meter. By the way, always keep that limitation in mind when working on any line-operated equipment, especially switching power supplies and transformerless "hot-chassis" TVs. Remember, unless there's line isolation from a power transformer, the chassis could indeed be hot, or it could be very cold: at ground.

If you do need to provide your own resistor across which to measure, keep in mind its current limiting effects on the circuit you're testing. The added resistance will cut the voltage down some, and increased impedance in the power supply line may induce motorboating or other circuit instability. Now and then, you may have to add a capacitor across the circuit side of the resistor in order to undo the impedance effects. In any event, always try to keep the resistance value as low as possible in order to minimize disturbance to the circuit. What sets the minimum value for the resistor? The sensitivity of your measuring instrument and the voltages involved. Those, of course, are a consequence of the current being drawn through the resistor. The less current, the less resulting voltage, thus the harder it is to read it. Having a sensitive meter really helps.

Time And Distance

I've written before about RF grounds and their peculiarities. To summarize: because of the rapidly oscillating nature of RF and the finite time it takes for electrical energy to propagate, it is possible for a ground point to be out of phase with the circuit. In other words, it may not be at the same potential as other ground points, at any given moment, depending on how far away from them it lies. As the signal frequency goes up, the wavelength goes down, increasing this problem. At 450 MHz, lines a few inches long can become tuned circuits, with vastly differing voltages at either end, at different times in the signal's cycle. At 3.5 MHz, those same lines will appear at the same potential from end to end, because the wavelength is so long that there's almost no difference over such a small space.

So, it pays to select your measurement ground carefully. Always get it as close to the signal point as possible. If you clip the scope's ground to a point 8 inches away in a 450 MHz circuit, don't be surprised if your RF measurements mislead you.

Meter As Receiver

Finally, keep in mind that your measuring instrument, be it analog or digital voltmeter, or scope, can and will rectify enough of a transmitter's RF to confuse itself. I've seen it happen with half a watt from an HT. You need to measure a DC voltage during transmit, and you get a number that just doesn't make sense. Chances are, your transmitter's RF is the culprit. In fact, you can use most analog meters as simple field strength meters just by transmitting with the antenna a few inches away, with no connection at all. There's no easy way out of this, except to use a dummy load.

Well, we're near the end of our measurement topic, and next time I'll tie up a few loose ends and move on to something else. Before I go, though, I need to respond to a reader whose letter I just recently received. He said he'd been trying to reach me for a long time to ask about a reference I made awhile back regarding DSP audio filters. My apologies; I've moved several times and I suspect numerous pieces of mail have not managed to follow me around from city to city. At the time, I was referring to the JPS NIR-10, which was one of the first available DSP units. Now, there are many on the market. I haven't had the opportunity to play with them, so I can't offer any recommendations, except to say that digital signal processing makes for some awesome audio filters which are dramatically better than even the best analog filters, and can do things no other technology allows.

Until next time, 73 from KB1UM.

QRP

Number 21 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Mikey's Big Adventure

Every now and then I get inspired and come up with an outstanding idea. Although I was inspired, this idea fell flat in the middle of the road. Let me explain.

I enjoy riding a bicycle. Although I've been less than active these last few years, I try to add up the miles when I can. In fact, I'm working at building up enough heart tissue to make the trip back and forth from work. I've been putting this off for two reasons. First, I'm lazy. Second, there are two "better call 911" hills (make that mountains) between here and there. So, to entice myself to get on the saddle and down the road, I decided I would add some ham radio to the bike.

QRP CW on a Mountain Bike!

I always carry an HT with me, so I can personally direct the ambulance to my location via the phone patch. But, I wanted more. Ah, yes! How about some QRP CW on forty meters as I huff and puff down the streets? I thought CW would be great, as the other guy would not be able to hear me wheezing and puffing as I peddled.

I started out by attaching a 40 meter loaded whip antenna to the rear sprocket holder on the bike. Mounting this antenna so it would not fall off required a lot of planning. Bicycles are not known for a smooth ride; I used a vise grip.

Now, this antenna measures about eight feet tall when fully assembled. Here was my first problem. How do you get your leg up and over an antenna that high? Well you don't. I had to get my fat butt on the bike by pulling my leg up over the handbars from the wrong side of the bike. I really don't know if there is a wrong side to a bike, but let's just say it's backward from what I'm used to doing. Talk about stretch marks!

Another problem came up with the antenna and its mount. The SWR was way too high, and nothing I did seemed to make it go down. I suspect the reason was a lack of metal under the antenna. I fixed the problem somewhat by adding a counterpoise wire that trailed behind the bike. I guess you could call it a "tiger's tail" for 40 meters. Having never gotten around to measuring it, I'll guess I had about 30+ feet of wire attached to the rear end of the Schwinn.

The first rig I tried was a Ten-Tec Scout. I put a 12 volt, 7 amp/hr battery inside the bag under the saddle. I mounted the Scout from the handlebars with a couple of rubber bungee cords and a small hunk of masonite. I now had power and a rig. All that I needed was a CW paddle.

And I made that out of an old Ten-Tec paddle assembly from a KR-series keyer. Nothing fancy, it held together with some Super Glue and cable ties. I fastened the mess to the right handlebar with several nylon cable ties. I could change gears, brake, and send CW, all with my right hand. I could tune the rig with my left hand and steer with the right if need be. Let me tell you, I was happier than a squirrel in a walnut tree!

> ***"There is no way you can send CW on a bike as you go down the road. The Scout is way too heavy for the Ohio potholes. The roads are too hard on Mike's butt. I'm getting too old for this. And never, never, never trail a wire behind your bike."***

"What the Heck Is *That!?*"

However, life has never been kind to me, and this project was to suffer the same fate. First off, put this image in your mind's eye: Here's this bright red mountain bike, me with my hot pink Lycra bike shorts, a pair of Italian racing gloves, and a green stocking hat over my helmet. My God, I stop traffic! Now, add on an eight-foot antenna, a radio belching out squeaky noises, and it's time to open up the "X-Files."

Then the trouble began. First, everything worked just fine sitting in the driveway. Although the Scout made quick use of the battery, several contacts were made at the 10-watt RF output from the Scout in its lowest power setting.

But then I started down the road. It became quite clear I could not tune the rig and peddle at the same time. Also, there were the potholes!

Massillon Potholes—Tourist Attraction

In the part of Ohio I live in, we are famous for our potholes. In fact, the city crews feed those critters a special food mix during the winter so they grow up big and deep. It's not at all unusual to hear someone calling for help from deep inside one come early Spring. The potholes really enjoy swallowing up small Fords with gusto! Why, up north towards the big city of Cleveland, Ohio, large groups of people come and just watch the potholes grow.

The first one I ran into knocked the rig all over the band. I moved from the lower end of the CW band to CHU Canada with one monster bounce! The second one bounced the rig right out of the bungee cords. I caught it before the Scout got a case of road rash.

I was not as lucky. Remember my counterpoise wire for the antenna? Well, just as I caught the rig, someone in a huge motor home ran over the wire. I guess you could say they got the tiger by its tail! Anyway, that stopped the bike instantly and up over the handlebars I went. The only thing broken was my pride. Lucky for me, I have an extra layer of fat on my butt. That's great stuff for cushioning a fall. So there I was, my idea flat in the middle of Stratton Avenue. My ego deflated, I hobbled back home.

Here's is what I learned:

There is no way you can send CW on a bike as you go down the road. Nope, I don't care who he is. The Scout is way too heavy for the Ohio potholes. The roads are too hard on Mike's butt. I'm getting too old for this. And never, never, *never* trail a wire behind your bike.

Where There's a Will . . .

But I'm not one to give up so easily. Oh no. I wanted to operate QRP with the bike, and by God, I was going to do just that. But with a twist. This time, I left the antenna at home. Swapped out the Scout for my Ark-40 and threw in a portable dipole.

I now ride down to Sippo park, grab a picnic table and pull out the gear from the saddlebags. I string the dipole in a tree and have some fun making QRP contacts. And if I get bored, I can always feed cashews to the ducks! 73

Photo A. Close-up of the Ten-Tec key paddle strapped to the handlebars.

Photo B. Nope! That's not a rubber duck antenna. It's what's left of my 40 meter antenna

Number 22 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Never Too Young

I recently had an experience that reminded me of the fact that you never know where or when potential hams may cross your path. Several months ago I met Joe LoVerde, a reporter for *New York Teacher* magazine. He and a photographer came to my school and spent the afternoon with my ham radio classes for an article they were doing.

Joe interviewed many of the children in my program as they gathered around the radio in the ham shack. He listened intently as we checked into the retired airline pilots' net on 14.280 MHz, and was delighted to observe the warm reception we received. Joe also enjoyed listening to the youngsters respond to stations from all over the world on the IMRA net. He had never really known about ham radio before; he made a real learning experience out of it.

One of the things that really impressed Joe was the very natural way that ham radio in the classroom could be used as a motivational tool in all the other curriculum areas. He readily saw the enrichment possibilities in social studies, science, language arts, and math.

Evidently, Joe was excited enough about what he observed in my radio classes that day to go home and recount his day to his family. Joe's eight-year-old daughter, Nicole, was totally enchanted with the stories her dad was telling. She was especially interested in the explanations about my classes having spoken to astronauts, and, of course, to Mickey Mouse in Disneyland, via the ham radio in the classroom.

Nicole lives in Staten Island, where she is a second-grader at P.S. 32 in Mary Jo Kling's class. Her dad describes her as "a very bright kid, who loves school, animals, the Power Rangers, and Elvis. She plays all sports—soccer, basketball, and hockey. She also enjoys dancing school." I would add that she is one of the cutest and most verbal eight-year-olds I've ever met.

Photo A. Joe LoVerde and his eight-year-old daughter, Nicole, at the I.S. 72 ham shack.

Well, Nicole thought it would be a good idea to do her social studies fair project on "The Uses of Ham Radio Today." So dad arranged for Nicole to come to visit my ham shack after school one day. This thoroughly delightful little girl interviewed me for her project and then accepted my invitation to speak on the 2 meter rig.

I've always been very fortunate in having tremendous support from the local radio clubs. Nicole was warmly greeted by Marty WA2YYX and Barry KB2YDW on the local Staten Island repeater. Both hams welcomed her and her dad to the wonderful world of ham radio after I introduced them on the air.

I especially enjoyed watching the smile break out on Nicole's face when she held the microphone and made her first contact. The ages of the youngsters that I deal with every day are 10 to 13. It was a real treat for me to see the excited, uninhibited reaction of this little girl on the radio for the first time. The older children are just a little more reserved in their initial reactions.

We weren't happy that an accident occured while Nicole was on the air, but it was a terrific demo for her to hear the quick and efficient way the hams reported a car crash on the Verrazano Bridge only seconds after it happened. She was able to include that incident in her written report explaining the usefulness of ham radios in the past and today.

Her report described the fun of ham radio as a hobby, and the usefulness of contacting police or other emergency organizations while the problem is actually happening. I was so excited when Nicole called to tell me that she was one of three finalists from her class. All of the finalists from the school had their projects on display in the gymnasium. Medals were given to all the finalists, with a gold medal going to the winner from each class. Nicole got the gold medal for her ham radio project.

The last phone call I got from Nicole was to let me know that she plans to study the Novice material I gave her, and to get her license this summer. We're arranging for her to come to my ham shack after school in the next few weeks so that she can get actual on-the-air experience. It's fascinating to see the ripple effects of sharing your own enthusiasm for ham radio. You never know where the ripples may go. I know you will all join me in wishing Nicole good luck with her studies. I'm sure we'll be hearing more from this talented young lady.

Photo B. The older children in my sixth- to eighth-grade classes are a little more "reserved" in their reactions

Never Say Die

Continued from page 4

If you know any hams who aren't reading *73* or *Radio Fun*, please let them know how much you're enjoying the publications. Next year I want to talk with twice as many hams at Dayton who read them. Only about 10% of the hams are subscribing to *73;* that's terrible! How can I get the other 90% to stop smoking and lose weight if I'm not reaching them? How can I get them to try our ham satellites? Slow scan? Packet? How can I maybe even get them to think?

My wife was with me at Dayton, how about yours? Sherry encourages me to buy ham gear, to get on the air and go to hamfests. She did make me promise that we wouldn't go to the banquet, so we had dinner instead with Mike Wengert HL9KT from Seoul. He's made our many visits to Korea lots of fun. He even helped me get my license as HL9WG. He's also lived recently in 9M8 and VS6. Heck, I don't even know who they had as the guest speaker at the banquet this year.

I brought along a suitcase full of my *We The People Declare War On Our Lousy Government* books and sold 'em all. Many readers stopped to say how much they've enjoyed the book. Now, if there were only some way to get one of the presidential candidates to read it! In it I explain a simple way to get any government bureaucracy to cut itself in half within three years and do it enthusiastically. I explain how to cut prison costs by 90%. How to cut health care costs, school costs, and so on. And all with substantial improvements in their services. But so few people care. Oh well, I've written about all that before. I'm running out of copies, but while they're left they're just $10 from Uncle Wayne's Bookshelf.

Sherry is after me to update the book for a second edition, plus add in the 336 pages of my *2020 Foresight* newsletters. Nothing that would probably interest you. Like my proposal for using amateur radio as the key to getting our kids to get into high-tech careers so America will have the workforce it needs to cope with the technology of the 21st century. I'll probably have to add at least a chapter on cold fusion, having gotten interested in that since I wrote the book.

The Flea Market

Hey, for once it didn't rain on Friday and Saturday, making the flea market more fun. It did rain on Sunday, but not much. I didn't even need my umbrella.

If I had the time (and a few more readers and advertisers so I'd have the money to do it) I'd like to double or triple the interest in the flea market. Of course I know how. Step one would be to get the HamVention Committee to allocate the flea market spots much earlier. Step two would be to put together a flyer with inexpensive exhibitor ads showing where we can find what kind of stuff. A Flea Market Guide.

With more and more of the exhibitors dealing in computers and accessories, the attendance at the HamVention could be expanded by attracting a few thousand computer hackers. This wouldn't hurt us hams since most of us are into computers too.

I started to see as many of the flea market exhibitors as I could, but with over 500 of 'em, and it taking me four to five minutes to say hello to each, I soon saw this was a losing battle. I don't know if the HamVention Committee would part with their list of flea market exhibitors or not. Probably not. So such a publishing project probably wouldn't be very successful. It's just that I hate seeing an opportunity to build our hobby being passed by.

For any ham interested in building, the HamVention flea market is a gold mine. Acres of parts at el cheapo prices. What a great place to load up! That's what I used to do when I had the time to build. Whenever I needed a part I'd buy ten, just to make sure. I ended up with a collection you wouldn't believe. Indeed, when I moved everything from my folk's home in Brooklyn to Peterborough it took four van trips, and they were so heavy one load broke the van.

"For any ham interested in building, the HamVention flea market is a gold mine. Acres of parts at el cheapo prices."

I'd not only completely filled my basement ham shack after 25 years of building, but also our garage, and three of my neighbor's garages I'd rented. By 1965, when I saw that the world was going IC I decided it was time to get rid of my old tubes and large parts. I held one whale of an auction and pretty well cleaned the place out . . . at around a penny on the dollar. Well, money has never been important for me, what I wanted was to find good homes for my beloved parts and equipment.

Every now and then I need a part and have some regrets. But not many.

The Manufacturer's Meeting

When I got back home from Dayton I found a notice in the mail that there was going to be an industry meeting at Dayton. Thanks a bunch. Well, I found out about it anyway and attended. It was run by the *CQ* Gang (as they call themselves). Last year they spent most of the meeting pushing the manufacturers to support their proposed series of commercially run hamfests. I gather that, as I predicted, the hamfests bombed. This year it was other things, but little of the meeting devoted to the main topic of interest to manufacturers: the current recession in the ham business.

The Japanese firms in particular have a big problem: the yen to dollar ratio, which makes it very expensive for them to build their equipment in Japan these days. I came to the meeting with a plan to help them cope with this problem, but when I got there I didn't see any of them attending. As a matter of fact, very few of the manufacturers bothered to come. So we heard at length from the *CQ* Gang and from some ARRL folk.

I have some ideas for what the next generation of ham equipment might look like. That's something I thought the Japanese would want to hear about. Plus my plan would make it possible to overcome some of the yen problems for them, and it would also help rebuild the American ham industry a bit. It was totally destroyed thirty years ago and has never really recovered. At the time I watched with some amusement as the ham industry financed its own destruction with ads in *QST*. Do I see history starting to replay?

What's Gone Wrong

The main problem for the ham industry is (a) that almost all the new hams are no-code Techs, so they're not buying all-band rigs. And, (b) very few of them are upgrading to General, which means the industry is still not selling all-band rigs. Thus, instead of investing maybe $2,000 or so in a rig, tower, and beam, new hams are buying $200 HTs.

Then there's the cut-throat dealer competition which has reduced markups to around 25%. If you are involved in retailing you know that dealers have to make more like a 50% markup on merchandise if they are going to make any money. And some industries work on a 100% markup (called "keystone").

Having been a retailer I know the routine. You have to pay for the store, employees, insurance, advertising, shipping, interest on inventory, and so on. A good location can be very expensive. Heck, no part of it is cheap. Even those 800 numbers cost a bundle. By the time I opened five computer software stores and stocked them with merchandise I had a couple of million dollars invested. If I'd have had to sell products with only a 25% markup I'd have been out of business in no time, so it's no wonder we have so few ham dealers these days.

Here we are, finally seeing some newcomers to the hobby, only they are isolated on the VHF bands and thus missing most of the fun the hobby offers. And, with the barrier of the 13-per code test, most of them have opted to live with what they have. So, when we see 3,000 or so newcomers being licensed a month, instead of the industry getting around $6 million in sales as a result, they're getting more like $500,000. By the time that's split among a hundred retailers it's going out of business time.

It gets worse. Of the around 300,000 General and up class licensees, only about a third are active. But let's say they buy a new rig every five years. That's a $1,250 buy every five years, or about $250 a year. And that's not far from what the hams are claiming to be spending in surveys. That comes to around $25 million a year in sales. To put that into perspective, that's about half what the readers of my *CD Review* were spending a *month* on compact discs, and what my *80 Micro* readers were spending a *month* on TRS-80 products. And that was just the readers of my magazines, not the whole industries. It's peanuts.

One thing that would help would be to combine the General and Tech licenses so Techs could get on the low bands. Another would be to go the Japanese route and allow Techs to run 10 watts of SSB on the low bands.

With the biggest ham market in the world being in Japan, American manufacturers haven't a chance to build much of a business. Japan has twice as many hams as we do, and with only half our population! All you have to do is look at their 600-page monthly ham magazine to see the difference. It's filled with fabulous construction projects and a much wider selection of ham gear than we have available. This also helps to explain why Japan is graduating so many more engineers, scientists and technicians than the US. And why almost all of our new electronic products are coming from Japan.

If we're going to attract kids to amateur radio we've got to make their entry more attractive. We're up against computers, computer games, the Internet, and an almost total ignorance of our existence. What we don't need is an artificial and now irrelevant code barrier plus a lack of any planned promotion by our elitist national organization, which has historically ignored and disdained newcomers.

ARRL Vs. FCC

The FCC rules regarding the code tests say nothing about not permitting testees to write down the dots and dashes on the worksheet and then translate them at their sweet convenience. The ARRL instructions to their VECs admits this, but then goes on to suggest that if clubs want to make up their own rules to prevent this that this is their prerogative. Wrongo! That's the way to set up a club for a really expensive lawsuit which could tap any members with deep pockets for a bundle.

I'm on record as absolutely despising hams who sue other hams, so that's something I would never, ever recommend. But if there are any shys . . . er, ham lawyers out there looking

for some fun with a class action suit, I might be able to put them in touch with some potential clients should any VECs decide to take it on themselves to rewrite the FCC by putting restrictions on worksheet notes or setting arbitrary time limits for the code test. If the FCC had wanted time limits set for the test they would have put that into their rules. Look, I suspect the FCC chaps are as irritated by this code baloney as many of us hams are.

I don't make any bones that I'm out to scuttle the whole darned code test deal. We've proven several thousand times over that this doesn't keep out the bad guys. We're up to here in bad guys, all of whom have passed the code test. What it is doing is discouraging youngsters, the people we need the most if we're going to keep the hobby going. I want to get that lousy mental obstacle out of the way so we can try to attract a few million young hams, instead of the dozens we're getting now. And I don't care how many grumbling old timers I have to run over to get this done. Including those fusty old ARRL directors you can't seem to help yourself from reelecting. What we need is term limits for directors. Like 10 minutes if they are over 50.

Will Anything Change?

Probably not. Unless you decide to do something about it yourself. The ARRL isn't going to change without your pressure. The FCC isn't going to change either, unless you force them with sheaves of petitions.

It's Impossible

When John Campbell W2ZGU, the editor of *Analog*, told me about the Hieronymus Machine I frankly didn't believe him. It was just too preposterous. It violated everything I'd been taught. It violated my experience. It was obviously completely impossible.

"If we're going to attract kids to amateur radio we've got to make their entry more attractive."

Then came Henry Gross' Wishing Machine, which was even more absurd. John was an amazing genius and he was into everything. A lunch with him was like riding an intellectual roller coaster, going into electrochemistry for a few minutes, then into nuclear physics, psychology, sociology, and so on. But when he came up with stuff that was patently absurd, even though the machines had been patented, I rolled my eyes.

I had the same reaction when pyramids came along. Little paper pyramids can sharpen razor blades? Sure. And mummify dead animals? Har-de-har. But what if little paper pyramids really can sharpen razor blades and there are photomicrographs to prove it? What do you do when something is clearly impossible, yet it happens?

Well, G. Harry Stine has fiendishly come up with seven machines you can build for yourself and test. They're all simple to make, and the really irritating part is that every blessed one of them works for most people. None of them should or even could possibly work. The nice part of it is that they all will work whether you believe they will or not. Even worse, they'll work with the double-blind scientific test too. You're going to have to face the fact that they all do work and that we haven't a scientific clue as to why.

The scientific approach to all this is to pooh-pooh it and not bother to test any of them since there's no known way they can possibly work. That's the approach some old line scientists have used with cold fusion, and never mind the dozens of labs around the world generating completely unexplainable large quantities of heat. It isn't possible, therefore there's no reason to check it out.

Now, if you'd like to upset yourself and prove the completely impossible is real, invest in Stine's book. It's 207 pages in paperback and is available from Top of the Mountain Publishing, Box 2244, Pinellas Park, FL 34664. Send $18 (postpaid) for Stine's *Amazing and Wonderful Mind Machines You Can Build*.

The book shows the tube version of the Hieronymus Machine, as well as a transistorized version, and even a new IC model that you can assemble in a few minutes. This gadget will tell you what metals are in anything you put by the input coil, and what percentages of each metal. This, of course is completely impossible. But it gets worse. You detect the presence of metals by feeling a plastic or glass plate which is over the output coil. Yes, this fool thing will work whether you believe it or not. It'll work for most people, but not all. Around 80%. And for those for whom it works, it works repeatably, even when the operator has no clue as to what is being tested.

It gets worse. The damned thing keeps right on working with the power turned off. Working repeatably. Now explain *that* to someone. But, alas, it gets even worse. It turns out you can

replace that IC circuit with an inked drawing of the circuit, connected to the input and output coils with thread instead of wire and it keeps right on working, like the Energizer Bunny. You do have to re-ink the battery drawing now and then to keep it running. Apparently the battery drawing runs out of juice when the ink begins to fade.

All this is pure hokum, right? It's so foolish you'd never try to build even the simple machines that Stine describes in detail. It's not worth reading about. Okay, fine, don't look through Galileo's telescope. Don't hang a couple nickels in a potassium carbonate solution and see if excess heat is generated. Laugh and jeer at gullible old Wayne. Obviously I'm losing what's left of my marbles. Well, that's what a bunch of readers were saying when I started pushing 2m FM and repeaters back in the 1960s. They said it again when I pushed microcomputers in 1975. I sure must have started out with one big bag of marbles to lose so many and still keep going. So make poor old Wayne look dumb. Get the book, build the gadgets Stine describes, and prove they positively won't work by testing them yourself and on a bunch of friends.

My grandfather showed me how to dowse with a beech tree branch when I was about seven years old. It worked for both of us. Dowsing works just fine for people all around the world. They dowse for water, oil, minerals, underground pipes, and so on. Nobody has a clue as to how or why dowsing works, so the pathological skeptics just refuse to accept it. To me, when something unexplainable happens, that's the time to start finding out why, not the time to say it's all a fake, never happened, and ignore it. We've lost a lot of valuable knowledge and experience via pathological skeptic pressure.

Just look at what the head of the DOE has been able to do to the American cold fusion research effort. He almost single-handedly has put America way behind many other countries in this new field, Japan in particular. The cold fusion pioneers in India and Italy are heroes, here they were ridiculed and humiliated. Well, that's what happens when our government gets involved with just about anything. The government seems able to screw up everything it does.

Virtually every major contributor to health care cost escalation has been caused by government meddling. Ditto our school system, which is the worst in the developed world and making us less and less competitive with the far better educated people in other countries. When Bulgarian school kids easily outperform ours it's almost time to do something about getting the government out of the education business. I keep harping on that, don't I? Well, you aren't *doing* anything.

Now send for that book and stop procrastinating. And renew your subscription to *73* while you're at it. Heck, subscribe to *Radio Fun* too—it's only $35 for the combo. (Every radio and TV program ends with a commercial, right?)

Number 23 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

JULY 8

PETOSKEY, MI The Straits Area ARC will sponsor a Swap & Shop, 8 AM-1 PM, in the 4-H Bldg. at Emmet County Fairgrounds. Talk-in on 146.68. For info, call *Harry Leiber N8OIV, (616) 347-6610.*

SALISBURY, NC The North Carolina "Alligator Group" will sponsor a "Firecracker Hamfest," 8 AM-2 PM at the Salisbury Civic Center. Auction at 1 PM. VE Exams at 1:30 PM, pre-reg. required, with 610, copy of license, and current fee sent to *Isabell Ledford, P.O. Box 826, Cooleemee NC 27014.* For Hamfest reg., write to *Walter "Alligator" Bastow, 3045 High Rock Rd., Gold Hill NC 28071.*

SOUTH MILWAUKEE, WI The 26th annual "Swapfest" of the South Milwaukee ARC, Inc., will be held at the American Legion Post #434 grounds, 9327 S. Shepard Ave., Oak Creek WI, 7 AM-2 PM CDT. Talk-in on 146.52 simplex and on local Rptr. For a free flyer, write to *The South Milwaukee ARC Inc., P.O. Box 102, South Milwaukee WI 53172-0102. Tel. (414) 762-3235.*

JULY 8-9

INDIANAPOLIS, IN The Indianapolis Hamfest Assn. will host the ARRL Central Div. Convention, and a Ham Radio/Electronics Flea Market, at the Marion County Fairgrounds. K9YJW will provide Talk-in, from 6 AM each morning, on 146.76(-) and 443.25(+). Contact *Indianapolis Hamfest Assn., P.O. Box 88677, Indianapolis, IN 46208. Tel. (317) 251-4407.*

JULY 9

BALTIMORE, MD The Baltimore Radio Amateur TV Soc. will hold its annual Maryland Hamfest/Computer Fest at the Maryland State Fairgrounds in Timonium. Vendor setup 2 PM Sat., July 8th. Tailgating area opens 6 AM, Sun. Buildings open 8 AM. VE Exams at 10 AM only. Pre-reg. required. Call *Les McClure W3GXT, (410) 833-8667.* Talk-in on 147.03/R and 224.96/R. For info, contact *BRATS Hamfest, P.O. Box 5915, Baltimore MD 21208. Tel./FAX (410) 467-4634.*

HINSDALE, IL Dupage ARC Hamfest Computer Show '95 will be held at Santa Fe Park, 91st and Wolf Rd. Commercial and Flea Market Set-up 6 AM. Hamfest hours 8 AM-3 PM. No VE Exams. Talk-in on the DARC 2M 145.250. Contact *Edwin Weinstein, 7511 Walnut Ave., Woodridge IL 60517. Tel. (708) 985-0527 eves.* Send SASE with check payable to *DARC, Hamfest '95, 7511 Walnut Ave., Woodridge IL 60517.*

PITTSBURGH, PA The North Hills ARC will hold their 10th annual Hamfest 8 AM-3 PM at the Northland Public Library, 300 Cumberland Rd. Talk-in on 149.69/.09 North Hills ARC Rptr. Contact *Gregg Corsello K3QK, 2021 Red Coach Rd., Allison Park PA 15101. Tel. (412) 366-7006.*

JULY 15-16

MISSION, BC, CANADA Maple Ridge, Mission and Abbotsford ARCs will present the 2nd annual AREP Expo and Ham/Computer Swap Meet, 9 AM-4 PM, at Mission Rec Center, 7th and Talbout St. Set-up at 8 AM. For info, write to *MRARC, 32750 Cherry Ave., Mission BC V2V 2T7, Canada.* For table reservations, call *Rob VE7JOK, (604) 826-8445; Terry VE7TAG, 465-5710; Steve VE7IIF, (604) 826-8445; or Fraser VE7OAB, (604) 826-7020.*

JULY 16

NEWTON, NJ The Sussex County ARC will hold its 17th annual Hamfest at the Sussex County Fairgrounds, Plains Rd., Augusta NJ, starting at 8 AM. Talk-in on 147.30/R, 224.50/R, and 146.52 simplex. Contact *Daniel Carter N2ERH, 8 Carter Ln., Branchville NJ 07826. Tel. (201) 948-6999.*

VAN WERT, OH Van Wert County Fairgrounds, US 127 South, is the location for "Hamfest '95," which will be held in the Commercial Bldg. by the Van Wert ARC, 8 AM-3 PM.

Talk-in on 146.850. VE Exams if you can pre-register by July 9th; send SASE or call *Bob High KA8IBF, 12838 Tomlinson Rd., Rockford OH 45882. Tel. (419) 795-5763.* For Hamfest info. call *Bob High, (419) 795-5763 before 5 PM: Bob WD8LPY, (419) 238-1877 after 5 PM.*

WASHINGTON, MO The Zero-Beaters ARC will hold its 33rd annual Hamfest at Washington City Park. Gates open at 6 AM. Registration for VE Exams will start at 9 AM. Talk-in on 147.240(+). Contact *ZBARC, P.O. Box 24, Dutzow MO 63342;* or call Dave *Randolph N0GLN, days, (314) 532-2477; eves. (314) 764-4999.*

JULY 21

NEWINGTON, CT The 14th Annual ARRL Digital Comm. Conf. will be held Sept. 8-10, 1995, at the La Quinta Conf. Center in Arlington TX. Anyone interested in digital communications is invited to submit a paper for publication in the *Conference Proceedings*. Presentation at the Conference is not required for publication. Papers are due by July 21st. and should be submitted to *Maty Weinberg, ARRL, 225 Main St., Newington CT 06111 USA;* or via Internet at *iweinberg@arrl.org.* Please contact Maty for detailed format requirements. For more info on the Conference, registration, and hotel reservations, contact *TAPR, 8987-309 E. Tanque Verde Rd. #337, Tucson AZ 85749-9399, USA. Tel. (817) 383-0000. FAX (817) 566-2544. Internet: tapr@tapr.org.*

JULY 21-23

PHOENIX, AZ The ARCA Ft. Tuthill Hamfest will be held at Coconino County Fairgrounds, Flagstaff AZ. Contact the *Amateur Radio Council of Arizona, (602) 440-2039,* for reservation info. VE Exams Sat. July 22nd, at 8:30 AM. No-code Tech class - contact *Morgan Riley N7DLW, (602) 938-4356.*

JULY 23

FREDERICK, MD The Mid-Atlantic DX & Rptr. Assn. will hold a Hamfest at the Marc Train Station in Brunswick, Frederick Cnty., Md. VE Exams. Flea Market. Brunswick Train Museum. Tent/Indoor spaces must be pre-reg.: write to *MADRA Hamfest '95, 230 N. Potomac St., Hagerstown MD 21740.* Talk-in on 147.060/448.125 MHz Rptrs.

JULY 27-29

COLORADO SPRINGS, CO The Central States VHF Soc. Annual Conference will be held at the Sheraton Colorado Springs Hotel, 2886 South Circle Dr. For Hotel Reservations, call *(719) 576-5900, or (800) 325-3535.* Be sure to ask for the Central States VHF Soc. rate. For Conference info, contact *Lauren Libby KX0O, (719) 593-9861;* or *Hal Bergeson W0MXY, (719) 471-0238.* E-Mail to *75151.2442@COMPUSERVE.COM (KX0O)* or *BERGESON@PPCC.COLORADO.EDU (W0MXY).* A special "Youth Program" for young hams, and beginners in VHF (regardless of age) will be offered on Fri. morning.

JULY 28-29

OKLAHOMA CITY, OK The Central Oklahoma Radio Amateurs will sponsor their 22nd annual "Ham Holidays '95" at the Oklahoma State Fair Park (Hobbies, Arts & Crafts Bldg.). Doors open 5 PM-8 PM, Fri., July 28th; 8 AM-5 PM, Sat., July 29th. Technical and non-technical programs, Fox Hunt, VE Exams, Flea Market. Talk-in on 146.67. Address all inquiries to *Ham Holidays '95, P.O. 851281, Yukon OK 73085-1281;* or CompuServe *75672.3475.*

JULY 29

ASHEVILLE, NC The 20th annual Western Carolina Hamfest will be held 8 AM-4 PM at the Haywood County Fairgrounds, near Waynesville NC. Sponsor: Western Carolina ARS. Talk-in on 146.16/.76 and 146.31/.91. Contact *Tommy Queen K4BNP, 12 Lynwood Circle, Asheville NC 28806. Tel. (704) 258-2639.*

CARLINVILLE, IL Macoupin County ARC, Inc. will hold their Computer Fair/Hamfest '95 at the Macoupin County Fairgrounds, 1/2 mi. north of Carlinville, on Rte 4, starting at 8 AM. Setup the night before or at 6 AM. Vendors, contact *Doug KA9HDZ at (618) 488-7249.* VE Exams, all classes, pre-reg. required. Call *(217) 854-8261.* For info. call *Dennis N9LQC, (217) 854-2365.*

KINGSFORD, MI The Mich-A-Con ARC will host the Upper Peninsula Hamfest in the Iron Mountain-Kingsford area at the United Sportsman Club in Merriman MI, starting at 8 AM. Setup at 7 AM, CST. Contact *William Bertoldi, Jr. KB8SBP, 709 Hamilton Ave., Kingsford MI 49801. Tel. (906) 774-0419;* or *Lou Gembolis KG8NK, 441 Balsam, Kingsford MI 49801. Tel. (906)774-2930.*

AUG 5

CLAYTON, NY The Jefferson County RAC, will hold their Hamfest 7 AM-5 PM, at the Clayton Rec. Park Arena. VE Exams at 9 AM; walk-ins welcomed. Talk-in on 146.70/.10. Contact *Jefferson County RAC, P.O. Box 523, Brownville NY 13615.*

AUG 6

ANGOLA, IN The annual Land of Lakes Angola Hamfest, sponsored by the Land of Lakes ARC, will be held 7 AM-2 PM at Steuben County 4-H Fairgrounds, corner of 200 W & 200 N, at Crooked Lake in Angola. Vendor setup 3-10 PM Sat., Aug. 5th; 4AM-7 AM Sun., Aug. 6th. VE Exams for all classes; sign up at 9 AM. Chicken BBQ. Talk-in on 147.180/.780 and 444.350/449.350 131.8 Tone. For Tickets, please contact *Land of Lakes Angola Hamfest, Sharon Brown WD9DSP, 905 W Parkway Dr., Pleasant Lake IN 46779. Tel. (219) 475-5897.*

MARSHFIELD, WI The Marshfield Area ARS will hold their 4th annual Picnic, beginning around 11 AM in Wildwood Park. Potluck. Swapfest. Talk-in on 147.180. All are welcome. Contact *Guy A. Boucher KF9XX, 107 West Third St., Marshfield WI 54449. Tel. (715) 384-4323. Packet: KF9XX @ W9IHW.WI.USA.NA.*

PEOTONE, IL A Hamfest/Computer Festival will be held at Will County Fairgrounds 6 AM-?, by the Hamfesters RC, Inc. Setup Sat. Aug. 5th 3 PM-11 PM. The main exhibition hall opens at 8 AM. Contact *John Fleming, 13800 Division St., Lot 215, Blue Island IL 60406. Tel. (708) 489-5872.*

SPECIAL EVENT STATIONS

JULY 4

WILLIAMSBURG, VA The Williamsburg Area ARC will operate KE4YVV 1300Z-2300Z, to celebrate the 219th Anniversary of the signing of the Declaration of Independance. Freq: 28.350, 24.950, 21.350, 18.150, 14.270, 7.270 and 3.870. For an unfolded certificate, send QSL and a 9" x 12" SASE to *Hershel Kreis KE4GWV, 145 Sand Hill Rd., Williamsburg VA 23188-6609.*

JULY 8

SIOUX FALLS, SD The Sioux Empire ARC will operate W0ZWY 1400Z-2200Z to commemorate the U.S.S. South Dakota BB 57 (WWII Battleship X) 50th Nat'l Reunion. Operation will be on CW and phone on the 80-10 meter bands. For a QSL certificate, send QSL and SASE to *SEARC, P.O. Box 91, Sioux Falls SD 57101.*

SOUTH POINT, OH The Lawrence County OH AR Emergency Services group will operate the Lawrence County OH Ohio River AR "River Days" Special Event Station WN8F, from aboard the Jewell City Sternwheeler. The event will run 11 AM-4 PM. Freq. 2M 146.715 & 146.610 Linked; 10M 28.400; 20M 14.240; 40M 7.240. Packet will also be on display and operating. Brochures about amateur radio and emergency services will be available to the public. Also, visitors will be encouraged to send a message to a friend Via Ham Radio.

JULY 9

WESTERN NEW YORK The ATV Group of Western NY will launch its second High Altitude Helium Balloon at 9 AM. Live video may be received on 439.25 MHz, 2M CW beacon on 144.34, and local 40M net, starting at 8:30 AM on 7.290 MHz +/- QRM. Overlay on video will display the call sign of WA2CXW, along with altitude, temp., and other info. For details, call *Roger Garbacz WA2CXW (716) 937-4478.*

JULY 13-15

SACRAMENTO, CA The Sacramento ARC will operate W6AK 8 AM-8 PM Pacific Daylight Time, to celebrate the Folsom Powerhouse Centennial. Operation will be voice on 10, 15, 20, 40 and 80 meters. The 10, 40, and 80 bands will probably be used the most. A special Centennial QSL Card will be sent to stations worked that send an SASE to *The Sacramento ARC, P.O. Box 161903, Sacramento CA 95816-1903.*

JULY 15-16

PLYMOUTH, MA The Mayflower ARC will operate KB1BQJ from the waterfront "Harborfest," 1400Z-2100Z, in honor of the 375th Anniversary of the landing of the Pilgrims at Plymouth Rock. Operation will be in the General portion of the 40, 20, 15, and 10 meter bands. For a certificate, send SASE to *MARC, P.O. Box 766, Plymouth MA 02362-0766.*

KINGSPORT, TN The Bays Mountain Radio Club and the Kingsport ARC will operate W4ZJA 1700Z-2400Z on July 15th and 16th, to commemorate the 75th Anniversary of their sponsor, Eastman Chemical Company. Operations will be on the General portion of the 40 and 20 meter phone bands, and the Novice portion of the 10 meter subband. For a certificate, send a QSL and a 9" x 12" SASE, along with your contact number, to *W4ZJA, Bays Mountain Radio Club, P.O. Box 3168, Kingsport TN 37664.*

JULY 15 & 22

RACINE, WI The Racine Megacycle Club will operate club station W9UDU to celebrate the 21st Anniversary of the largest Lake Michigan fishing contest, "The Big One," Salmon-A-Rama, July 15th and 22nd, from 1500Z-1900Z. Operation will be on the lower 25 kHz of the General 20 and 40M phone/CW bands, and 28.400 MHz. Contact may also be made on 147.27(+) (Lakeshore Rptr). Packet operators may connect with W9UDU@K9RRS.EN62GK.WI.USA.NOAM; Subject: Salmon-A-Rama; Text: Finish the sentence: Fishing

Lake Michigan is great because . . . For a certificate, send your QSL and an SASE to the *Racine Megacycle Club W9UDU, Box 3, Racine WI 53401-0003.*

JULY 16

SOCORRO, NM The Socorro ARA will operate NA5N from 1100-1700 UTC, from near Ground Zero - Trinity Site - in the Central New Mexico desert, to commemorate the 50th Anniversary of the world's first atomic bomb test. Listen on the General phone and CW portions of the 80, 40, 20, 15, and 10-meter bands (depending on propagation). A QRP station will operate in the QRP frequencies of 7.040, 14.060, 21.060 and 28.060 MHz. For a QSL/Certificate, send QSL and business size SASE to *Socorro ARA, Trinity Site Event, P.O. Box 522, Socorro NM 87801.* Trinity Site will be open to the public the morning of July 16th. The White Sands Missile Range Stallion Gate (east of San Antonio NM) will be open to the public 5 AM-11 AM MDT. On July 15th, the Nat'l Radio Astronomy Observatory will offer guided tours of the Very Large Array radio telescope, west of Socorro.. For info and accommodations, contact the *Socorro County Chamber of Commerce, P.O. Box 743, Socorro NM. Tel. (505) 835-0424.*

JULY 20-23

COLORADO SPRINGS, CO The International Tesla Soc. will operate KC2Q/0, 1600Z-2400Z, daily, on 7.297, 14.297, 21.397, and 28.397. KC2Q/0 will QSL directly to YOU.

JULY 22-23

STRATFORD, NY The Fulton County Mahlon Loomis Committee will operate W2ZZJ, 1300Z-2000Z, each day, on the General class phone portion of 40, 20, and 15 meters, and on the Novice 10 meter phone band; also, on area 2 meter FM Rptrs. This is to celebrate the 169th Anniversary of the birth of Dr. Mahlon Loomis, the American wireless telegraphy pioneer. For a certficate and literature, send QSL, contact number, and #10 SASE to *W2ZZJ, 5738 STHWY 29A, Stratford NY 13470.*

JULY 27-AUG 2

GREENVILLE, NC The following stations will operate during a DXpedition to St. Paul Island (CY9): Ron AA4VK/CY9; Murray WA4DAN/CY9; Bob KW2P/CY9; Vance W5IJU/CY9. Operation will be on all bands 160M-6M. Modes: SSB, CW, and RTTY. QSL via *Murray D. Adams WA4DAN, 403 East 14th St., Greenville NC 27858.*

JULY 29

EAST GREENWICH, RI The Fidelity ARC will operate K1NQG 1300Z-1800Z, to coincide with the annual Yankee Tune Up at the New England Wireless and Steam Museum. Phone: lower portion of the 20 meter General subband; CW: the Novice portion of the 40 meter band. For a certificate, send QSL and SASE to *Bill May N1LEJ, 20 Montana Ave., Coventry RI 02816.*

JULY 29-30

RUTLEDGE, TN The Lakeway ARC will operate KS4QK 1400Z-2300Z in conjunction with the Grainger County Tomato Festival. Operation will be in the middle of the General 20, 15, and 10 meter Novice phone subbands, and 146.50 2 meter. For a certificate, send $1, a 6" x 9" SASE, and your QSL card to *Perry R. Hensley, R #3 Box 566A, Rutledge TN 37861-9300.*

AUG 4-6

LANNON, WI Members of the Milwaukee ARES will operate W9WK to celebrate the 5th annual "Picnic Ham" held at Menomonee Park. Operation will be in the General phone and CW bands on 75, 40, 20, 15, and 10 meters. For a certificate, send QSL and a 9" x 12" envelope (with 2 units of postage) to *W9WK, c/o John Leekty, 757 N. Broadway, Suite 306, Milwaukee WI 53202.*

AUG 5

ROCHESTER, NY The AUXHAMS, the U.S. Coast Guard Auxiliary AR Operators, will operate WA2RXE, 1400Z-2000Z, to celebrate the Birthday of the US Coast Guard. Operation will be in the lower General phone portions of the 80, 40, 20, and 15 meter bands, the Novice 10 meter subband, and 146.925 Rptr. For an unfolded certificate, send QSL and 9" x 12" SASE to *AUXHAMS, WA2RXE, P.O. Box 90411, Rochester NY 14609.*

Number 24 on your Feedback card

HAM HELP

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full (8 1/2" x 11") sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters 1 or i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

WANTED: Details of "Cold Plating" as advertised in *Popular Mechanics* or *Popular Science. Keith R. French, P.O. Box 9, Berowra NSW 2081, Australia.*

I need a REGENCY Regulator 5700 Controller, or someone who can repair it for me. *Ed Quinn, P.O. Box 91, Sewaren NJ 07077-0091.*

The San Francisco Shriners Hospital for Crippled Children has a stamp club for inpatients, as well as for recovering outpatients, that have an interest in stamp collecting. Children are given a stamp album when they are in for treatment, and stamps are regularly distributed and forwarded to club members. Their current need far outweighs present contributions. They would greatly appreciate any foreign stamps (and/or foreign coins and currency) being forwarded to them at *San Francisco Shriners Hospital for Crippled Children Stamp Club, 1701 19th Avenue, San Francisco CA 94122.*

I am in need of manuals for the following: (1) SHEA-TRON Amp. It is a 10W in, 100W out VHF amp. Frequency range is 136-175 MHz. (2) OLYMPIA Electronic Compact RO. It is a printer only; no keyboard. I will gladly pay for expenses to get these manuals. *Bill Fletcher AF9B, 4358 Crawford Dr., Madison WI 53711-4849.*

I am looking for schematics and/or a manual for a LAYFAYETTE HE-20T CB transceiver. I will pay for copies and/or postage. *Brent Putnam, 14-B Debra Ann Ln., E. Falmouth MA 02536.*

BARTER 'N' BUY

Number 25 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rt. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the September 1995 classified ad section is July 13, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS.** Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

SUPERFAST MORSE CODE SUPEREASY Subliminal cassette. $12. **LEARN MORSE CODE IN 1 HOUR.** Amazing supereasy technique. $12. Both $20. Money-back guarantee. Free catalog, SASE. **Bahr-T8, 150 Greenfield, Bloomingdale IL 60108** BNB221

WANTEDWestern electric amplifiers, tubes, speakers & parts. **Free Quote!** 1-800-251-5454. BNB268

KPC-3 TERMINAL PROGRAM User friendly, split screen, AutoConnect 32K scrollback buffer, Integrated Editor, Save & send files easily. SASE for **FREE** details. $29.95. **ComTreK,** Box 4101, Concord NH 03302-4101. BNB271

DWYER WIND SPEED INDICATOR only $55.00 plus $4.00 S/H. For home or office. Accurate, low-cost, practical. Roof mounted pickup. Send check or M.O. to: **RAD-MON COMPANY,** Dept A, Box 751, Marathon NY 13803-0751. (NY Residents add Sales Tax) BNB285

2 METER INTERMOD Our notch filter eliminates the pagers in the 152-153 MHZ region that are responsible for 99% of intermod. No insertion loss, no need for +12, transparent at 70CM. See Jan. 95 CQ product review. Ruggedly built in solid brass. Hipower version VHFDN152 W/UHF conn. $62 HT version W/ M/f BNC VHFDN152HT $68.$4 S/H. We also ship C.O.D. no charge. **PAR Electronics** 407-586-8278 **FAX** 407-582-1234. 6869 Bayshore Dr. Lantana, FL 33462 BNB288

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

KENWOOD AUTHORIZED REPAIR. Also ICOM. Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322. BNB310

NOW ON 40 METERS! New, knob-tuned w/digital display, synthesized QRP transceiver. Complete kit only $199.95. S&H $7.50 (continental US). **GUARANTEED TO WORK.** For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

REPEATERS VHF & UHF. Built from GE Master-II Mobiles. Tuned to your frequency. Starting $249. **Call evenings,** (503) 378-0646. E-Mail: Ham440@aol.com BNB335

PROPAGATION

Number 26 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

Conditions This Month

July is not expected to be a very good month for DX on the HF bands. The poorest days are likely to be: 5-6, 9-10, and 29-30. The best days should occur on: 1-3, 12-15, 21-23 and 25-27. As you can see from the daily chart, HF signal propagation for the remainder of the month is anticipated to be Fair or transitioning. Poor weather and/or other remarkable geophysical phenomena could center around the 5th, 18th, and 29th.

10, 12, and 15 Meter Bands

Sporadic E propagation on many (G) or (F) days, with good signal strengths of short duration and quick fading. The ionized clouds drift with the high-altitude winds. Expect skip to 1,500 miles or so, and beam across the equator for possible contacts in the opposite hemisphere. These bands will close at sunset.

17 and 20 Meter Bands

Twenty will be best, and sometimes 17 will be almost as good, but not as heavily occupied. If open, the higher-frequency band will provide the longest skip. Twenty will remain open after sunset and sometimes late into the evening. Seventeen will close at dark or shortly after. Possible grey-line DX along the terminator is a bonus.

30 and 40 Meter Bands

Excellent nighttime possibilities on evenings when QRN is low and "conditions" are Good. Thunderstorms between you and your target can make copy difficult if not impossible. Daytime short skip out to 1,000 miles is frequent, and nighttime skip to 2,000 miles or more will occur less regularly. Thirty meters will behave more like 20, and 40 meters will behave more like 80 on many occasions, due to the height of the reflecting layer at that time. Always check the next-higher and next-lower bands.

80 and 160 Meter Bands

Expect lots of QRN. You'll hear very few signals on 80 during the day, and none on 160. These bands are the nighttime bands in summer, and it pays you to keep a sharp ear open after sundown. On particularly good nights with low noise, you will find both long skip and DX on both bands. Avid DXers must be patient, however, because in summer there's almost always noise present. I'd recommend that you use the long summer days and evenings for building up better antennas for these bands, and wait until fall for conditions to improve. W1XU

JULY 1995						
SUN	MON	TUE	WED	THU	FRI	SAT
						1 F-G
2 G	3 G-F	4 F-P	5 P	6 P-G	7 F	8 F-P
9 P	10 P	11 P-F	12 F-G	13 G-F	14 F-G	15 G-F
16 F-P	17 P	18 P	19 P-F	20 F	21 F-G	22 G
23 G-F	24 F	25 F-G	26 G	27 G-F	28 F-P	29 P
30 P	31 P-F					

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WESTCOAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

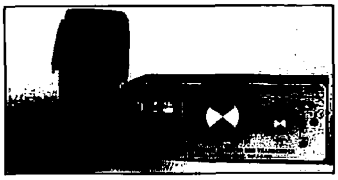
GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R.								20	20			

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

NEW PRODUCTS

Number 27 on your Feedback card



MFJ

Turn on the MFJ-9420, 20 Meter SSB Travel Radio and you'll marvel at how well it performs for only $219.95

Weak stations roll in with surprising clarity. MFJ's Constant Current speech processor cuts through noise and QRM.

Take along world-class DX performance with exceptional power on your next vacation or business trip. The MFJ-9420, a microphone, and your antenna easily fit into your briefcase or carry-on luggage.

It features simple, portable operation, amazingly sensitive audio amplifier, a quiet, double-balanced mixer front-end, single-conversation clarity, and plenty of gain. If a signal is there, you'll pull it in loud and clear!

MFJ-9420 has a real calibrated S-meter, not a useless bargraph, making it a peaking tuner, so finding the best beam heading is clear-cut. The meter also monitors speech processing levels during transmit. No annoying synthesizer jump or obscure keypad commands to deal with. Enjoy effortless tuning with a custom-built reduction drive ball-bearing VFO capacitor.

Get big audio—powerful audio—even in heavily noise-populated locations, thanks to a special Signetics audio chip and a rugged three-inch speaker.

The 9420 transmitter was specially designed from the ground up to deliver maximum talk power from popular easy-to-carry power sources, such as NiCd, D cells, or the special MFJ-4110 wall adapter power supply.

Built to last, the bullet-proof Motorola PA transistor runs cool and easily tolerates 3:1 VSWR and accidental feedline shorts or opens.

The conservative design features premium plated-through PC board, quality components, handsome brushed-aluminum panel, and a tough vinyl-clad case to ensure years of dependable service. The unit carries MFJ's "No Matter What" full one-year unconditional guarantee.

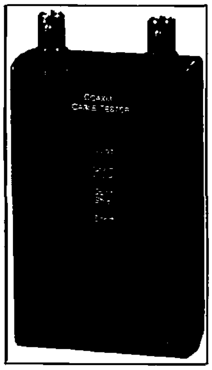
For more information or to order, contact any MFJ dealer or MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762; (601) 323-5869, fax: (601) 323-6551, or toll-free orders (800) 647-1800. Or circle Reader Service No. 203.

MAGGIORE

Maggiore Electronic Laboratory has announced the Model R1 Repeater line with a starting price of $589.00. Used as a main system or a backup, the units start as a complete receiver and transmitter in a rack-mountable, 19" x 3.5" x 9" deep, completely enclosed steel cabinet, with DC power cord, panel-mounted fuse and power switch. Separate compartments house transmitter, receiver, and controller. All repeaters are designed for 100% duty cycle at -20° to +60° C and are available in power outputs from 5 watts to 35 watts in VHF and 2.5 watts to 20 watts in UHF. Power outputs adjust easily in matching high-power amplifier inputs. All repeaters now come with the new Hi Pro Studio Quality Audio and ultra stable Hi Pro TCXO Oscillators. A computer-controlled, voice-synthesized CAT-300 with autopatch and autodialers, voice messages, and controller inputs and outputs is also available installed. All repeaters include a 2-year warranty. For more information, contact Maggiore Electronic Laboratory, 600 Westtown Rd., West Chester, PA 19382; (610) 436-6051, fax: (610) 436-6268. Or circle Reader Service No. 201.

RF INDUSTRIES

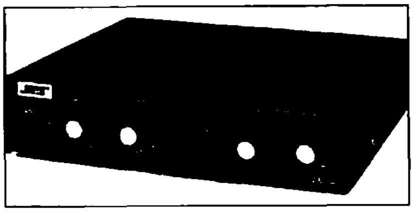
RF Industries introduces the RFA-4017-1 Coaxial Cable Tester. With this convenient, low-cost cable assembly tester, the bench and field technician can quickly and easily test cables with BNC male ends. Adapters (sold separately or packaged in the RFA-4017 kit) enable the technicians to test cables with termination other than BNCs.



The cable tester, powered by a 9-volt battery, is lightweight, small, and completely portable. The LED panel of the front of the tester indicates pass or fail. If the result is fail, the panel saves you valuable diagnostic time by indicating whether the failure is due to a short, open conductor, or open shield. Installed cable can easily be tested by using two testers.

Available from RFI distributors throughout the US, Canada, and Mexico. For more information, contact RF Industries, Ltd., 7610 Miramar Rd., San Diego, CA 92126-4202; (619) 549-6340, (800) 233-1728, fax: (619) 549-6345. Or circle Reader Service No. 205.

JPS COMMUNICATIONS



JPS Communications, Inc., announces the most advanced DSP noise reduction and filter unit available to Amateurs and SWLs: the NIR-12 Noise & Interference Reducer and Filter Unit. The unit is a state-of-the-art audio signal processor designed to provide the user with maximum flexibility to reduce or eliminate most types of interference from received voice, CW, and data transmissions. Dual Digital Signal Processors (DSP) provide simultaneous bandpass operation, noise reduction, and multiple tone removal. The Spectral NOTCH filter eliminates multiple tone interference from "tune-ups," foreign broadcast carriers, CW, RTTY, etc. A multilayer printed circuit board provides superior shielding to virtually eliminate radiation from the DSP data bus. Two methods of noise reduction are provided: Improved Spectral Subtraction (NIRR) and Improved Dynamic Peaking, to give the operator the best audio noise reduction possible.

For experimenters, access to the dual DSPs is provided via RS-232 on an internal header. The manual supplied with the unit describes this implementation.

The Improved NIRR mode of noise reduction automatically enhances voice, CW, or data signals by recognizing the speech, CW, or data and reducing the amplitude of all signals which are not part of the desired information. In addition to providing a continuously variable processing level, the NIRR control features an AUTO position to give the optimum noise reduction based on the measured signal-to-noise ratio.

The Improved Dynamic Peaking noise reduction features an external PEAK FACTOR switch to allow the operator to control the "aggressiveness" of the PEAK mode. When this mode is used in conjunction with the NIRR mode, exceptional noise reduction can be attained without damaging speech components or intelligibility.

All modes in the NIR-12, except NIRR mode, operate in "real time" with very small delay, so the unit may be used in all data modes, including ARQ modes popular with AMTOR and PACTOR. The Finite Impulse Response (FIR) filters provided in the unit have very steep skirt selectivity, linear phase in the passband, and minimum passband ripple, all desirable characteristics for good data and SSTV reproduction. The bandwidth of the filter is variable from 50 Hz to 3200 Hz, and the center frequency of the chosen filter is variable from 200 to 3400 Hz. The combination of variable filter bandwidth and variable center frequency provides exceptional "user-friendly" operation.

Installation is quite simple: The unit gets its audio input from the receiver speaker output, line output, or headphone jack, then provides volume-adjustable processed audio from its own built-in amplifier to power an external speaker of 3- to 8-ohm impedance. A line output, unaffected by the volume control, is provided for modem or phone patch.

The NIR-12 requires 12 VDC @ 1 A peak. Power adapters are available from JPS at nominal cost. Mating connectors are supplied with each unit. The unit has a one-year factory warranty and is fully upgradable.

For more information or a data sheet, contact: JPS Communications, Inc., P.O. Box 97757, Raleigh, NC 27624; (919) 790-1011, fax: (919) 790-1456. Or circle Reader Service No. 202.

GORDON WEST

Gordon West Radio School instructs both amateur radio courses and commercial radio curriculums, and now offers high-fidelity, long-play code cassettes, "commercial rated" to pass commercial first class, second class, and third class radiotelegraph licenses, as well as any level of amateur radio examination.

Radiotelegraph course 1—"Learning the International Morse Code" accelerates code character recognition with 5 wpm word rates sent with 16-20 wpm spacing. "Gordo" narrates the random runs and gives tips on preparing for any type of code exam.

Course 2—"CW speed building, 5–16 wpm" is for anyone who knows the code, but plans to build up to 16 wpm for the commercial radiotelegraph random code group test or an amateur radio General Class code test.

Course 3—"CW speed building, 10–27 wpm" prepares applicants to pass the radiotelegraph second and first class exams, with room to spare for the amateur Extra Class exam.

Each course contains six long-play cassettes, narrated by Gordon West, and packaged in a sturdy plastic cassette holder. Instructions are spoken on the tapes after each practice run.

Each course is $29.95, plus $5.00 postage and handling. Available from amateur and commercial radio dealers, or from Gordon West Radio School, 2414 College Drive, Costa Mesa, CA 92626; (714) 549-5000. Or circle Reader Service No. 208.

AUGUST 1995
ISSUE #419
USA $3.95
CANADA $4.95
A WGI Publication
International Edition

73 Amateur Radio Today

VE7PMR's "SOLAR" LANDER

Packet Radio Intro
19,200-Baud Packet
Packets & Palmtops
Packets From Space
Tube-Type TNC

73 Reviews:
HP 200LX Palmtop
ICOM Z1A Dual-Band HT
Standard C508A Dual-Band HT

Construction:
Single-Chip IDer
The Octopus
Precision Voltage Standard

THE TEAM

PUBLISHER/EDITOR
Wayne Green W2NSD/1

SENIOR/TECHNICAL EDITOR
Mike Nugent WB8GLQ

EDITORS
Joyce Sawtelle
Victor Lapuszynski
David Witham

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Dan Harper
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

TECHNICAL DRAWINGS
Mike Nugent WB8GLQ

GRAPHICS MANAGER/ PAGINATION
Linda Drew

DESIGN/PRODUCTION
Joan Ahern

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

CIRCULATION
To subscribe: 1-800-677-8838

WAYNE GREEN, INC.

Editorial Offices
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

Subscription Services
1-800-677-8838
Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*, Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

73 Amateur Radio Today

August 1995
Issue #419

TABLE OF CONTENTS

FEATURES

REVIEWS

Why does this man look so content? Because he's working manned and unmanned satellites with relative ease and rather ordinary gear. You can, too! See page 26.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: Borrowing ideas from NASA, and devising some of their own, VE7PMR and friends engineered and installed a solar-powered packet node that's survived some extremely harsh conditions. Read about their adventure, beginning on page 12.

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents ©1995 by Wayne Green Inc. No part of this publication may be reproduced without written permisson of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: Castin' yer glazzies on this piece o' prose has just drawn you into a legal obligation to involve youngsters in your ham activities. F'rinstance, invite a kid to help install a new antenna. Explain and teach as you work, and then take him/her into the shack to hear the results while munching on something tasty. (Food's the key—my elmer hooked me with barbecued ribs!)—Nuge WB8GLQ

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Colorado Springs In July

If it isn't too late, maybe you can make it to the Tesla Society conference, July 20-23, where I'll be giving a talk on the latest developments in cold fusion. There will be a bunch of hams there; so make it if you can. They always have some great speakers and you are bound to find yourself getting interested in something new and exciting. How about a 10-pound, 10-horsepower motor? That new way to destroy radioactivity I've written about? Biomagnetics? There will be papers on free energy research, transmutation, health hazards, and advanced technology. Call 719-475-0918 and tell 'em Wayne sent you. The four-day conference is only $250. Heck, the recent cold fusion conference cost almost three times that. And wait'll you see some of the books they have for sale! I came back last time with a suitcase full.

If you're into ragtime music (which you should be), you can follow me to nearby Boulder every evening for the ragtime festival, which is on the same weekend. Scott Kirby, my recording star, will be performing. You really don't want to miss him.

Now don't tell me you can't afford the airfare. Tsk. Just get a Continental Airlines credit card and get your free flier miles the way Sherry and I do. We flew first class to London and back from Paris for the cold fusion conference, all on flier miles. And she's taking a couple of her granddaughters to Hong Kong this summer the same way.

If you'd been reading my travels booklets (see Uncle Wayne's Bookshelf), you'd know all about these things. That NSD also stands for Never Squander a Dollar.

Virginia Beach

Okay, if you miss my Colorado Springs talk, you've got one more chance to hear Uncle Wayne live. I'll be talking this year again at the Virginia Beach (VA) hamfest on July 23. That's not far from Washington DC. What better way to save the $5 I charge for my talk on tape? And I know from last year that they throw one heck of a good hamfest; so make the trip and say hello in person. Ask for a QSL card. And don't put it off until next year. A good friend of mine who was 20 years younger just dropped dead of a heart attack, so I could go pffft at any time.

Like most hamfests these days, the flea market is loaded with computer stuff. If you know any hackers, get 'em there. The flea market is indoors, so even if they come up with Dayton-type weather, you'll keep dry. I'd say a good half of the exhibitors were computer oriented last year.

I also had a fabulous time at the nearby Edgar Cayce Foundation book store. That's where I found some of the more interesting books I've been reviewing. I'll be there again, credit card in hand.

Set aside July 23-24. For details, if you need 'em, you can call 804-486-3800. But don't try climbing the White House fence until after the hamfest.

History Repeating

A chap asked me how come, if cold fusion is so good, that the media haven't picked up on it. I explained that this is normal. I've been through this before, so I'm not surprised or even particularly frustrated.

When the first microcomputer was announced in January 1975 I immediately saw the potential (and wrote about it in my editorials in *73*). I started looking around for someone with computer smarts to hire as an editor for a microcomputer magazine. I called and wrote to the editors of every computer hobbyist newsletter I could find, asking if they were interested. It wasn't until May that I found one and we got started immediately, with the first issue of *Byte* coming out in August. From day one until the issue was on the presses, it took us only six weeks to generate subscribers and articles. Well, I drew heavily on *73* authors of computer articles. The magazine was done entirely by my *73* staff, other than the editor, including the ad sales.

I wrote the subscription letters and mailed them to every name I could get from people selling computer accessories and to the members of computer clubs. I wrote and sent ad sales letters to potential advertisers. I called my *73* authors for articles. It was a hectic six weeks.

Then, when the first issue came out, I took it personally to visit the major potential advertisers such as MITS in Albuquerque, Sphere in Salt Lake, and South West Tech Products in San Antonio. I stopped off and showed it to my friend Ed Juge in Ft. Worth and got him hooked. He later sold his ham store and became a bigwig at Radio Shack as a result.

But the mainframe and minicomputer crowd weren't impressed by microcomputers, which they termed "toys." They were led astray by the main computer publication, *Computerworld*, which spared no opportunity to make fun of micros and ridicule them. I wonder if there is the basis for a class-action suit against that publication for leading the industry astray. I personally hold *Computerworld* mostly responsible for the disaster which eventually hit Wang, Data General, DEC, Prime, Centronics, and a hundred other smaller companies.

By the time the minicomputer companies finally discovered the power of the microcomputers, it was too late for them to cope with the change. Tens of thousands have been thrown out of work as a result.

So here we are with history repeating itself. This time it's the fossil fuel and power companies which are going to go the way of mainframes and DEC minicomputers. Can Texaco, Exxon, BP, Shell, Citgo, and so on, really go the way of RCA and Honeywell mainframes?

Just as these days I'm sending letters and faxes about what's going on with cold fusion to Rush Limbaugh, Paul Harvey, CNN, AP, *The New York Times, The Washington Post, Time, Newsweek, Dateline NBC, 60 Minutes,* and so on, twenty years ago I was doing the same to the major news media of the day, trying to alert them to the importance of the microcomputer. The results are the same: zero.

I suppose it was the same with the harness-makers and buggy-whip manufacturers when the automobile came on the scene. Are any of the old slide rule companies making electronic calculators? No. How many of the old watch companies are still around? Very few. All those companies failed because they didn't see changes coming. And changes can be upon us before we know it, unless we do our homework.

Look at the millions of people who've been put out of work by automation or the moving of their jobs to lower-wage countries. Sure, if they'd been doing their homework, they'd have seen it coming and taken the time to develop new skills. Instead, they worked at the same job for years and spent their spare time having fun. Then, when the ax fell, they were astounded, confused, and angry. It sure wasn't their fault. Blame the company. Blame the government. But don't blame yourself.

Speaking of which, how secure is *your* job? Communications and computer technology changes have eliminated many middle management jobs, and will be eliminating more. Automation and cheaper foreign workers will be putting more blue-collar workers out of work unless they develop new and more needed skills. This is one reason why I've been preaching entrepreneurialism for so many years. When you own the company, you may pay more attention to the future so as not to be taken by surprise by new technologies. Or not.

CD-ROM legal libraries are putting thousands of young lawyers out of work as law firms computerize their law libraries. It wasn't that long ago that insurance companies had hundreds of statisticians with Monroe or Friedan calculators on their desks. Monroe? I remember when, far too late in the game, Monroe tried to change to computers. I've got an old Monroe calculator out in the barn somewhere. It was a $1,000 item at one time and a real marvel. I even mounted it in my Porsche Speedster for rallies and had a winning streak as a result.

Then along came the Curta calculator, which did the same job, only was the size of a pepper grinder. It was made in Liechtenstein for use as currency converters for European banks. So I went to the factory, talked to the prince who ran the country and the factory, and arranged to import 'em for rally use. I sold a ton of 'em. Of course, I was into car rallies at the time.

These days the same job can be done by a small electronic calculator.

Rallyists also needed very accurate watches. To win a rally, you often had to average less than a half-second error per checkpoint over a dozen or two checkpoints. A watch that was off by a half second in six hours could lose a rally for you. So I went to Schwenningen, in Germany, and had the Hanhart company make a special 17-jewel, 1/100-minute stopwatch for me to sell through my Radio Bookshop, along with the Curta calculators and other rally paraphernalia. I made enough money selling rally equipment by mail order to buy a second Porsche. I also converted and sold push-button surplus radios just tuned to bring in CHU and WWV for checkpoint timing use. What's the point of my arriving at a checkpoint exactly on time if their watch is off by a half second? And that happened to me every now and then. It was frustrating to lose because my watch was more accurate than their's.

Rallies are great fun. You must have an expert driver who can keep exactly on time, no matter what. And you need

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Jeff Bussard N3EVN, Moon Twp. PA I just watched a presentation on C-Span concerning the "deauthorizing" (their words) of the FCC. It seems that a conservative "think tank," with support of House Speaker Newt Gingrich, is proposing that the FCC be reduced to an executive department reporting to the president. The "new" FCC will simply be engaged in brokering spectrum on behalf of our government. How much spectrum one purchases and what one does with it will not be within the FCC's jurisdiction. No more regulations on content, mode, or who will operate within it. Let the free market determine what use is best. It's all for sale! Individuals, companies, partnerships, etc., are all invited.

The concept, which seems valid, goes like this . . . All spectrum is an asset, just like land. It can be occupied and utilized by the owner. If that owner wishes to lease it, or directly use it for broadcasting, cell-phones, data, etc., he can. Or, he can speculate and sell it for a profit or loss. The FCC would simply be the recorder of deeds.

Spectrum use laws would be handed over to the states to define, within constitutional limitations, what the owner can do with the spectrum (just like zoning laws). If someone interferes with your spectrum, then you can take him to court (trespassing).

Under this concept, if there still isn't an amateur radio service which would be provided strictly as a government charity, radio amateurs at large might have to ante up to purchase spectrum and then manage their spectrum themselves.

Even if the ARRL came suddenly to their senses and actually purchased some small spectrum for hobby purposes, information throughput would have to increase ten- to a hundred-fold to compensate for reduced bandwidth availablity! CW, FM, SSB, and RTTY would all be dinosaurs by comparison. New digital modes, including some that haven't even been invented yet, would emerge. At least the spirit of adventure in amateur radio could come alive again.

Anybody could purchase spectrum and start his own amateur radio service, not just the ARRL. This is the intent of reducing FCC authority in the first place. If you don't like the ARRL's service, sign on to someone else's. Remember, whoever gets the most revenue to support their spectrum investment wins.

Steve Katz WB2WIK, Chatsworth CA Rege Dvorsky WA3LKT in his June letter has a lot going for him. He acknowledged that his new grounding system worked because of "potluck." And he expressed an interest in many facets of our hobby which seem to bypass much of the crowd. I agree with him, but I have some suggestions.

It doesn't take money to work the satellites; it takes time, dedication, and ingenuity. I set up a local fellow on OSCAR-13 Mode J with $100 worth of used gear and he's having a ball. We're working on setting him up for Mode S for less than $200, although he'll have to build the uplink transverter from a kit, with which I'll be happily helping him. Since you'll be transmitting and receiving on different bands, fancy equipment really isn't required (although it may be nice and look pretty). I worked the first pass of OSCAR-VI back in 1970 using all home-brewed gear that cost maybe $50 to throw together.

I realize that "turnkey systems" are the idea du jour, and these are fine for those with more money than ingenuity. But you don't have to spend thousands of dollars to get into the satellite game. Your bucks will be better spent home-brewing some small projects and sending a $25 donation to AMSAT, which can use it to help build more satellites.

If you've tried working AO-21 and *Mir* without success ("no luck with my dipole antenna"), I'll bet it was either bad timing, poor operating technique, or less than optimum dipoles causing the problem. And this would not be unusual. Most newcomers to the sats don't really know how to do it—it takes time and experience. There are dipoles, and there are *dipoles*. Some work great; others don't, even though they're cut exactly per formula and resonate perfectly. SWR is no measure of efficiency. Get those dipoles out in the clear, free of obstructions (especially obstructions above the antennas which block their view of the sky), and they'll work fine. I've worked *Mir* with 5 W output from my tuned-down Ten-Tec Scout and a dipole. But my dipole was installed up 60' above the ground, above all the local tree limbs. It makes a huge difference. Find a couple of tall trees and get that wire up in the very top branches.

We've also worked (I say *we* because it was a club operation) the high-altitude sats with QRP from a Field Day site, using exactly 5 W output (and all battery-powered gear) on 70cm to a 16-el, circularly polarized yagi on a 3' tripod that was ground mounted. We did this at K6CAB/6, the club Field Day station for the Conejo Valley ARC here in southern California. Anyone can do it with the right technique. Although we were using a $2,000 FT-736R, the contacts would have been just as easily made with a home-brewed $40 transverter. It doesn't take much to run 5 watts.

I love your attitude, and wish more hams had it. Just take a little more time, use a bit more patience, hone your operating skills until they're razor-sharp, and you can do anything. Ham radio needn't be an expensive hobby. I've been a ham since I was 13 years old (golly, 30 years ago!) and have won major DX contests, but have actually spent more money on skiing equipment, restoring old cars, stamp collecting, and many other hobbies than ham radio ever required. Keep up the good work; you won't be disappointed.

Klaus Kramer DL4KCK, Koln, Germany Wayne, your idea to transmit manuscripts, circuit diagrams, and pictures via FAX equipment on the amateur bands is great, but not exactly new! At least in Germany we have been doing it for many years. In 1971, Manfred May DJ1KF (ex-DC6EU, now AGAF vice president) experimented with Siemens KF-108 fax machines. He adapted their in- and output to amateur radio transceivers and installed the special mode "facsimile" in DL. This AM-FAX mode was very susceptible to interference, so we changed to FM-FAX with modulation frequencies similar to SSTV (1,500 Hz black / 2,300 Hz white). Because of improved fax machines from 3M and Xerox that we adapted to our needs, we were able to exchange nearly photographic quality pictures with many grey levels and even the small, printed text from amateur radio magazines.

The analog fax standard 120 lpm and IOC 288 was used in Europe on the HF bands, while a rising number of VHF-amateurs used 240 lpm and IOC 204 with FM. Since the drum fax machines smelled strange while receiving (chemicals were burnt off the expensive special paper sheets), in the eighties more and more solid-state memory converters were used—for instance, "Wraase SC-1" from DL2RZ. With steadily improved memory chips we were able to display 256 x 256 pixels with 64 grey levels on the attached video monitor, and a "flash-A/D-converter" within the "SC-1" allowed us to store and transmit "live pictures" with nearly TV-quality from a b/w-video camera. Color shots were restricted to typical slow-scan resolutions (128 x 128 pixels), but some hams tried to get higher resolution pictures by collecting the red, blue, and green color portions one frame after another in the fax mode.

At last the rapid development of home computers, especially the Commodore Amiga, gave a decent "kick" to the sending of high-quality picture transmission on the HF bands. In 1988, DF4PV began his first experiments on 80m with an Amiga fax program, written by his younger brother Volker Wertich. This receive/transmit program, plus a little converter board attached to the parallel port, was accompanied by the Amiga-SSTV program which introduced two innovative ideas: The Wraase mode "quasi 96" (color SSTV) can be doubled in duration to 192 seconds by a software switch on the graphic user interface, and by another switch you can suppress the typical sync pulses (1,200 Hz) on transmit and receive. This new mode, called FAX-SSTV, combined the advantages of a low-band color SSTV transmission (only 1,500-2,300 Hz) and the crystal-controlled line sync that is used with FAX (it cannot be interrupted by noise peaks).

At about the same time AEA released the Amiga Video Terminal program and converter, which presented the highest known color picture resolution of all: 320 x 480 pixel in 188 seconds, also working without line sync pulses. The "new modes" (Robot 1200C extensions, Martin 1-4 and Scottie 1-4) took over the "sync free" mode on receive, but only now the JV-FAX program developed by DK8JV supplies the real color fax quality (640 x 480 pixels) that we had dreamed of. With SSB modulation it uses the maximum channel capacity with 360 lpm and IOC 204. In FM it provides better resolution with 240 lpm. The mode is named "ham color" or "JV color."

Meanwhile, the graphic power of the IBM-PC class with all necessary cards has nearly reached Amiga levels, and with JV-FAX version 7.0 all the usual SSTV modes as well as weather fax from satellites and color fax pictures with excellent quality are a reality. Amiga users can choose now between several programs with true color (24 bit) and high-resolution picture transmission. The dream has come alive.

If you are thinking about using normal office fax machines on the amateur bands, that would be a setback in quality and performance. First, the resolution never reaches the possible 256 grey levels of computer fax programs (not to mention the missing colors); and second, office fax transmissions are based on duplex connections with digital signals (max. 9,600 bit/s) and waste too much time at the beginning with a special "training sequence" that finds the highest possible speed for the data transmission. In Germany, some packet radio specialists tried to introduce this mode into their net, but without success. The time lost to connect was too big and data speeds on the SHF links between digipeaters surpass 38,400 bit/s by now. It's better to use old analog fax machines (i.e., 3M2346) as a scanner for photographs and text sheets. Modern amateur fax programs can receive that signal, process and transmit it with high quality.

I am transmitting a fax bulletin once a week on 2m with news and technical information. How about one powerful ham station doing that on every continent? In IARU-Region 1 the entire SSB section of the low bands can be used for FAX and SSTV transmissions. Now hams need to get busy and do it!

QRX . . .

Super Elmer!

Toby Metz KB7UIM has a great thing going with the Voice of Idaho Amateur Radio Club. Toby's Eagle Scout Service Project involves taking a small group of deaf people, teaching them what they need to know to get their ham tickets, and then getting them on packet! The city of Boise has donated computers and radios for the cause. The VOI Club bought the TNCs and crystals for the radios. Then, through a money-raising project, Toby earned enough to get the rest of the items needed to complete the project, like power supplies and antennas. One person, Bill Blohm KC7JSD, has already gotten his Tech and is well on his way to General. Two others, a nine-year-old and a twelve-year-old, are going for their no-code Tech tickets. Heather Whitestone, Miss America, sent Toby and his students autographed pictures and personal notes of encouragement. Way to go, Toby!

Wayne On-Line!

Yep, if you check the Prodigy Hobby Bulletin Board, Ham Radio division, you'll find good old Uncle Wayne...whenever he has the time. Now, via Prodigy, you can be the 42,478th person to tell Wayne that you don't always agree with his editorials. Maybe Wayne should issue a certificate. Ten dollars if you don't always agree with him. And $5 if you do. Now you know where to find him, with no problems of propagation or QRM.

Good Club!

The Port St. Lucie (Florida) Amateur Radio Association gets a gold star. (1) Their newsletter is interesting and informative. (2) The club is sponsoring hidden transmitter hunts. (3) They're active in all sorts of community projects, such as providing communications for the American Heart Association annual Bike-A-Thon, a March of Dimes Walk-A-Thon, and a Blessing of the Fleet. And how about the ham PR of holding their Field Day effort on the front lawn of City Hall! Instead of in the boondocks somewhere!

ARLS007 SAREX STS-70 Postponed

Space Shuttle Mission STS-70, which is scheduled to carry the Shuttle Amateur Radio Experiment, has been postponed. Mission managers have decided to repair damage done by woodpeckers in the foam insulation of the external fuel tank. The foam prevents ice from building up on the tank. The repairs will be done at the shuttle Vehicle Assembly Building, requiring the Space Shuttle *Discovery* to be removed from the launch pad during the week. The mission may be rescheduled for sometime in August.

Mission STS-71, which will also carry the Shuttle Amateur Radio Experiment, is still scheduled for no earlier than June 22. Following a Flight Readiness Review last Friday, mission managers decided not to select an official launch date due to ongoing work aboard the Russian *Mir* Space Station that needs to be completed prior to the Space Shuttle *Atlantis'* rendezvous and docking. The launch team at the Kennedy Space Center will continue vehicle processing work so that *Atlantis* will be ready for launch anytime on or after June 22. An official launch date is expected to be announced in about one week. *TNX ARRL, KC5BTL, and Kennedy Space Center Public Affairs Office*

10 GHz Activity

The Rochester Group VHF Journal reported on a wonderful opening across Lake Ontario. Bob Golden VE3OIK, set up on a hill, gave the Rochester hams an exciting time, with S-9 signals as they moved in 10-mile jumps along the shore. Not bad for an 85-mile hop on that band! The Journal points out that there is a need for more 10 GHz beacons. There are only a dozen in the US, compared to 10 in the UK and 30 more in Europe. The result is that most of the band openings are never noticed. But even when there is no opening, the 10 GHz band has plenty of uses, such as replacing wasteful 450 MHz repeater links. Uncle Wayne managed to work seven states on the band, with the longest path over 100 miles, and none shorter than 50 miles. Either use the band or face losing it. The Journal has lots of info on gear and operating, so send $10 to subscribe to Rochester VHF Group, Box 92122, Rochester NY 14692. Do it NOW!

Six Meters Open For The Summer

The more adventurous Techs are setting up camp on 6m and enjoying the usual summer openings. The band can sound like 20m at times. W4OO reports contacts all through W2 and 3, KP4, V31, TI2, and so on. Often the whole midwest is pouring through into Florida. The least you can do is get a rig and good antenna set up for 6m and start listening for the many beacons. Thanks to the North Florida Amateur Radio Society's *Balanced Modulator.*

Rescue at Sea

Amateur Radio has once again been a life saver on the high sea. The crew of a yacht that nearly sank off the Mendocino coast is safe and back on dry land. This, thanks to a Ham radio operator in Canada who picked up their distress signal when Coast Guard officials nearby could not. The 36-foot ketch lost its rudder and was drifting helplessly in 24-foot waves off Point Arena Thursday, June 1st, when Doug Burrows in Alberta heard their faint mayday calls on his radio.

Burrows called the U.S. Coast Guard in San Francisco, which dispatched a cutter and helicopter. The three crew members, who stayed with their boat, arrived at the Coast Guard Station Golden Gate the following day. The yacht was towed in by a Coast Guard patrol boat. *TNX Amateur Radio Newsline*

Free Speech Limited!

In addition to not being legal to yell FIRE! in a crowded theater, you are also not allowed to screw up a repeater to demonstrate your mental imbalance. Repeater trustees can ban any user they please, according to the FCC and backed by the courts. It's a pity when a club has to get a court order restraining some nut case ham from using a repeater. But then, while we have a filter (the code) to keep 90% of aspiring hams out of our exclusive club, we have no sanity test.

"Sky Night" Forming!

Would your ham club like to coordinate with astronomy clubs in your area to conduct a joint public "Sky Night" event, centering on the Perseid meteor shower? Activities would include visual observation, meteor-trail-bounce communication, conversations with other Sky Night sites around the country, and an opportunity to send messages to friends in other cities via National Traffic System nets.

Interested parties should send contact information to Peter Coffee AC6EN (E-mail: CompuServe 72631,113, or Internet 72631.113@compuserve.com) to help in planning this event. *TNX AC6EN*

Show Airs on Shortwave

On June 5th, the weekly ham radio talk show "Ham Radio and More," produced and hosted by Len Winkler KB7LPW, began airing on WWCR, tape-delayed, twice per week. Listen for it each Monday at 3:00 AM ET on 7.435 MHz and again every Saturday at 5:00 PM ET on 12.60 MHz. *TNX Amateur Radio Newsline*

FCC on the Internet

The FCC has instituted a homepage (http://www.fcc.gov) as an entry point to the Commission's on-line resources. The page features selectable buttons to go directly to high-interest items such as the Daily Digest, the Commission Agenda, Auctions, and current rule makings.

A button called "Getting Information" provides a tour of what information is available and where it can be found on the site, and provides links to available on-line documents. There also is a link to the FCC telephone directory.

A general mailbox for electronic mail to the FCC is: fccinfo@fcc.gov. *TNX ARRL*

Tube TNC: A Packet Breakthrough!

Have the hottest packet signal on the air.

by Phil Anderson WØXI

At the recent Tucson Amateur Packet Radio (TAPR) annual meeting in St. Louis, one of the presenters proposed yet another TNC. A prominent amateur in the audience then challenged this presenter to justify such a project, asking "Why do we need another TNC?" This reminded me of an idea that had been circulating within my own cranial LAN a few months before: How many tubes would it take to make a TNC and what would its specs be like? Well, here goes.

Concept

First things first, what do we want our Tube TNC (TT) to look like? Should it be super simple, or should it match the features of one manufactured today? Since this choice is arbitrary and I'm familiar with the Kantronics KPC-3[1], let's make our TT look like it. As you may know, a basic KPC-3 ships with 32K of random access memory (RAM), 512K bits of erasable programmable read-only memory (EPROM), a 63B03X Hitachi microprocessor (μP), and a 3105 Texas Instruments (TI) 1,200-baud modem. In addition to these large-scale integration (LSI) parts, it contains some additional chips: one DS14C88, two 74HC14s, two 74HC00s, a crystal, resistors, and capacitors.

Design

Second, now that we've picked a TNC for comparison, how many tubes will the TT need to have? This second question is not so simple. The 63B03X μP data sheet doesn't indicate how many transistors there are within the chip! However, my copy of the *Reference Data for Radio Engineers* (RDRE) gives us a good enough estimate: The 6502—the popular early-days workhorse—contains 5,000 transistors in its 160- by 160-mil chip! Assuming all the other chips in the KPC-3 have fewer transistors than the processor, I'm going to estimate that the KPC-3 contains roughly the equivalent of 10,000 transistors. Wait, don't yell yet! I'm not counting the SRAM and EPROM. You see, we'll have to use *core* memory in our TT.

Third, we'll have to pick an appropriate tube. Hams licensed 50 years may object, but I've selected the 6EV7, a relay control twin-triode by RCA[2]. Its physical outline is pictured in Figure 1 and additional features are listed below:

- two triodes in one tube
- 250 VDC B+
- 2.5 watts plate dissipation!
- miniature 9-pin socket

With these "facts" in hand, we can begin to picture our TT. By the way, for tradition, let's call it the TT-1. It's going to be big, it'll consume a lot of power, and it must by necessity use magnetic-core memory. If we don't use core memory, the number of transistors for the beast will simply grow way beyond the 5,000 I envision. I'm assuming, of course, since we smartly picked a twin-triode, that we'll need only 5,000 transistors (rather than 10,000) to replace the KPC-3's micro-processor, modem chip, and associated glue logic.

While a 6EV7 consumes just a few cubic inches of volume real estate, we can't expect to pack them against each other. That is, we can't assume the size of TT-1 will be just 5,000 times the volume taken by just one 6EV7. I just went downstairs and measured my refrigerator—not sure why—and its dimensions are 22 by 30 by 60 inches (39,600 cubic inches). While five thousand 6EV7s would fit in there, it would be way too hot; we're talking about generating nearly 25,000 watts. That's the equivalent of four hundred sixteen 60-watt light bulbs turned on continuously!

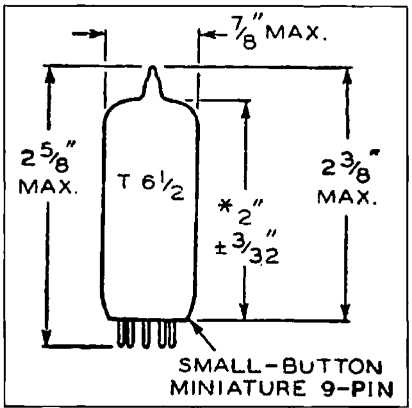


Figure 1. 6EV7 physical layout.

So what have we got? Let's list TT-1's features:

Power: 25,000 watts
Display: Christmas bulbs, for TX, RX, CON, ACT, and MAIL!
Tubes: 5,000 twin-triodes
Data memory: 256,000 cores for the "RAM" program
Memory: 512,000 cores for the "EPROM"

By the way, the RAM memory feature listed is really neat. You no longer have to worry about battery-backed RAM for your mailbox. The cores retain their individual "bits"—a one or zero—without power! We've got a really neat display, too; you have your own supply and can change them every Christmas: colored lights! You won't need a home furnace any more, either, for TT-1 puts out the BTU!

Operational Cost

But there is one big problem! This beast will cost you an arm and a leg in electrical bills if left on continuously as a digipeater or node. Here's my calculation, based on KW-H power rates for Kansas City:

Kilowatt-Hours/year = 25,000 watts x 24 hours x 365 days = 219,000 KW-H

Yearly electric bill = # kilowatt-hours x \$/KW-H = 219K x \$0.10 = \$21,900

Maybe we should settle for programming a bit more modern computer. Perhaps we could use a Digital Equipment Corporation PDP-8 or PDP-12, or perhaps we could use an IBM System Model 50. On second thought, perhaps we ought not to build this project!

References

1. *KPC-3 Reference Manual*, Kantronics, Inc, 1995.
2. *RCA Receiving Tube Manual*, RCA, 1961.
3. *Basic Engineering Thermodynamics*, Zemansky, McGraw Hill, 1975.

TT-1 Performance

Question: Would the Tube TNC, dissipating 25,000 watts continuously, heat your house?

Answer: A typical house in Kansas City, according to my high-efficiency furnace brochure, demands 2,000 heating load hours per year, and the average load is 70,000 BTU/hr. So, it would seem that the average house in KC needs roughly 140 million BTU/year. Additionally, the specs for my furnace indicate that it puts out 96% of the rated input capacity, or 124,000 BTU/hr. Thus, my furnace is capable of supplying the "heat" I need in roughly 1,000 heating hours per year. I pay \$0.37 per one-hundred cubic feet of gas (ccf) and I use about 1,000 ccf per year. So, my yearly gas heating bill is \$370.00. Not bad.

The question still remains: Can the Tube TNC supply these needed BTU? Our TT-1 dissipates 219,000 KW-H, so we need to relate that to BTU. My thermodynamics book[3] appendix gives us the answer:

1 KW-H = 3360 BTU, so
219,000 KW-H = 735 million BTU

That means our Tube TNC is capable of heating roughly five houses. It's a heat-LAN!

VE7PMR Packet Solar-Powered Node

Is packet worth nearly freezing on a mountain? Sure!

by Dennis Wilsher VE7EMS

Penny Mountain Packet Repeater, at 6,400 feet above sea level in the Rocky Mountain Trench in northern British Columbia, Canada, came into operation on September 3, 1993. Designed to operate in lightning storms, winds up to 120 mph, -54° F temperatures, 15-foot snowfalls, it does it all without missing a beat.

Background

Having been raised in that area in my childhood, I was more than familiar with the extreme conditions old Mother Nature can play on anything man might attempt to put together . . . or try to keep running. There are the grizzly bears, porcupines, and wolverines that like to chew up snowmobile seats or just roll things over to see what is under them.

Early in 1993 I sat down with Frank VE7ENX in McBride, and the subject came around to building a link, whether VHF voice or packet, to Prince George from McBride. I bounced the idea around about putting a packet node on Penny Mountain, where Rocky Mountain Trench does a 45-degree bend to complete the 150-mile distance to the nearest BBS at Prince George. Frank was pretty enthusiastic about the idea.

Researching

Access to the mountain is up an old forestry road made in the early 1960s; but since the game (grizzly) use the road as a trail quite regularly, it is well worn. Also a private cabin is located about half a mile below the summit, completely outfitted for one occupant. What a bonus!

I bought a small DT50 motorbike to get up the mountain to check the path in June. My first attempt had me leaving Prince George at 4 AM and getting to the bottom of the mountain via a new logging road. I took along a couple of two-gallon gas jugs and a car battery strapped to the front of the bike, a dual-band antenna, a laptop, my 741A Kenwood, and a PK-88. My new DT50 powered out halfway up the mountain. I tried pushing the bike but, because I was a smoker, I had to lie down and almost had a heart attack right there. Then it started to hail!

At this point I almost gave up on the whole idea, but I figured I might as well see if a packet contact to P. G. was possible. With a garbage bag over the radio equipment sitting on the motorcycle seat, I connected to YXS 50 miles away with only 5 watts. Great!

Photo A. The PMR machine comes in for a landing.

Photo B. A view of the PMR from the air.

I turned around and went back to civilization to regroup—tired, wet, and exhausted.

Stan VE7SSS and I went to the local library and spread out topographical maps over half the library to check the path from his BBS-VE7FG to Penny Mountain. We concluded that it would be close, but we would clear Tabor Mountain by 300 feet.

I sold the DT50, bought a TY250 trail bike, and left again in July with the same equipment (but with extra jets to re-jet the carb at the higher elevation). I made it to within 200 feet of the top, but I chickened out because it got too steep for my limited bike experience to cope with. Voice operation was good as I walked around with my 2-1/2-watt handheld. There wasn't a repeater for 120 miles around that I couldn't raise.

I set up the packet station and connected to Prince George and to McBride with no sweat, running 4 watts to a mag-mount antenna sitting on a rock.

As a wicked-looking storm was coming in from the east, my time was limited. I moved down the slope to the south about 200 feet to try another path. The idea was to put the node below the summit so as not to attract lightning and to keep it from hearing nodes in Alberta. I also wanted to pick a spot where the wind would keep the snow build-up below the solar panels in the winter.

It worked great and the signals were off the scale. To mark the point, I sprayed the rocks and moss with fluorescent red paint.

Putting It Together

Next I went to local clubs to sell the idea. After explaining to them where Penny Mountain was and what I was planning, a few local packet experts said it couldn't be done. The handheld and batteries would freeze; lightning would blow it up; solar panels would not work in this country; it's hard to access; and on and on. Hmmm . . . guess we would have to design it to overcome all these problems.

I contacted a helicopter company and was told that 700 lbs. was all they could lift to 6,400 feet, at a charge of $1,000 per hour. As I hadn't won the lottery lately, I decided I would have to figure out some way to get the system up to the site for free.

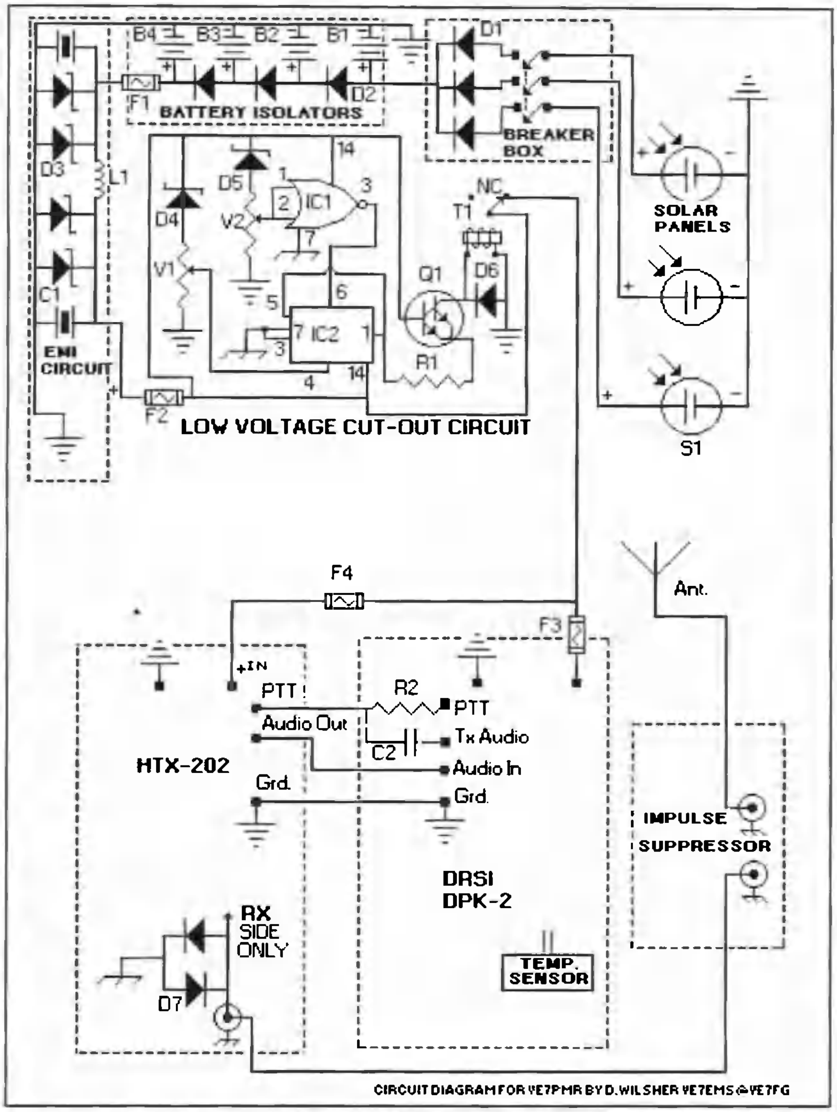


Figure 1. Circuit diagram.

Photo C. Author Dennis VE7EMS and Shorty VE7HRC after the landing. Says Dennis of the "Mars or Bust!" sign, "This unit is a lot cheaper than the failed Mars explorer . . . and it works!

Photo D. The PMR's internal components.

Photo E. VE7HRC (on ground) and VE7EMS (atop the unit) work on the "solar lander module."

For the structure, I realized I would have to design something that would be light but strong, and that would not blow over. So why not copy the Apollo lander idea?

To keep the components and batteries dry and somewhat warm, I took a donated, dead 12-cubic-foot deep freezer, removed the compressor, and filled the empty compartment with spray insulation foam. I then insulated the outside of it with another 3" by laminating it with styrofoam SM using a half-dozen or so silicon tubes. This gave me an additional R-30 insulating factor. The wiring to the panels was old 14-gauge electrical cable, steel-jacketed to protect it from the elements and "critters."

I put the freezer inside a welded 2" by 2", 1/8"-thick angle iron structure, 3" by 3", 1/8"-thick angle iron construction at the base, and 4-foot legs with adjustable feet for strength. All angle iron was welded together solidly using 7018 rod (rated at 70,000 psi). I did not want the unit falling apart when lifted by helicopter. I managed to keep the unit's weight (with the 200 lbs. of batteries) down to a total weight of 700 lbs., but it was close.

The batteries are vented through the bottom of the freezer by a system of aquarium tubes in series, with the vent caps drilled and plastic Ts glue-gunned into the caps. This prevented the inevitable explosion hydrogen gas would make if not vented properly. My wife Tracy VE7TLW gets credit for the battery-venting idea.

The airtight condensation problem was cured by changing silicon gel capsules (donated by pharmacist Dan VE7PHA) in the freezer every year.

Circuitry

Radio Shack's HTX-202 hand-held transceiver draws only about 65 mA on receive. The DPK2 DRSI drew less than 50 mA before the deviation kit was installed. The low-voltage cut-out circuit draws only about 15 mA and is designed to prevent the batteries from discharging below 12 volts, which would reduce their life expectancy and let them freeze as their specific gravity fell with temperature. Wires and coaxes were kept as short as possible. I soldered any connection that I could. For any I couldn't solder, I used conductive silicon grease.

I was only able to acquire batteries of different capacities; therefore, I installed isolation diodes between them, resulting in a voltage

drop of 0.34 V across each diode. This meant that when the voltage was at 12 volts at B4, the actual voltage was 13.02 maximum at B1.

The EMI protection circuit I built (designed for me by Chris VE7EQN) is equivalent to some $200 commercial units.

To protect the GaAsFETs at the front end of the HTX-202, I soldered two diodes back to back across the input of the front end. There was no noticeable reduction in sensitivity (per ARRL recommendations of a lightning spike nearby of over 0.2 V).

VE7PMR Solar Node Parts List

Ref. No.	Qty.	Description
S1	3	1-amp 20-V commercial solar panels
D1	3	1N5401TR (3-amp 100-V) diodes
D2	3	ECG 5812 (6-amp 100-V)diodes
F1	1	5-amp fuse
C1	2	Siemens Type B1-C75 (75 V breakdown voltage)
D3	4	1.5KE16CA (16.00 V breakdown voltage)
L1	1	4 turns 2" W of #14 (solid) wire
F2	1	5-amp fuse
V1	1	1k pot (set at 12 V)
V2	1	1k pot (set at 11 V)
D4, D5	2	5-V zener diode
1C1	1	ECG 4001
1C2	1	ECG 4013
Q1	1	NPN Darlington transistor
D6	1	1N4003 diode
F3	1	2-amp fuse
F4	1	500-mA fuse
R1	1	3,000-ohm resistor
R2	1	2,200-ohm resistor
C2	1	0.1-µF capacitor
T1	1	40-mA 12-V relay SPST 6-amp contacts
D7	2	1N914 diodes
HTX-202	1	Radio Shack (set at 3 watts, squelch opened)
DPK-2	1	DRSI DPK-2 1,200-baud TNC
IMPULSE	1	IS-B50 Polyphaser Corp.
Antenna	1	commercial Fiberglas, 18-ft. long, 6-dB gain
B1	2	1,000-amp 12-V deep cycle batteries
	1	1,000-amp 12-V conventional battery
	1	700-amp 12-V conventional battery

VE7PMR Remote Readings

```
PMR:VE7PMR} WELCOME TO PENNY MTN.
adc
PMR:VE7PMR}
2.3 Deg C
13.1 DC V
mh
PMR:VE7PMR}
Callsign     Pkts        Port       Time         D e v .
Type
VE7EMS       421         0          0:0:0        2.9
VE7FG        9019        0          0:0:3        2.5
PMR          475         0          0:0:6        2.9
VE7PAD       2087        0          0:0:18       2.4
VE7HRC       100         0          0:51:17      3.1
VE7DTI       1           0          3:43:52      2.5
VE7DPG       164         0          7:48:38      2.8
VE7ENX       16          0          10:58:40     2.4
stats
PMR:VE7PMR} Statistics
L1 Tx % : 8 8 0 3 6 0
L1 DCD% : 33 24 39 68 55 8
L1 RxOvr: 0 0 0 0
L1 TxUnd: 0 0 0 0
L2 RxCRC: 93 0 170 0
L2 heard: 385 0 836 0
L2 recvd: 242 0 121 0
L2 sent : 260 5 166 12
L2 RxRNR: 0 0 0 0
L2 RxREJ: 0 0 0 0
L2 TxRNR: 0 0 0 0
L2 TxREJ: 0 0 0 0
L2 fails: 0 0 0 0
L3 frwd: 0 0
L4 recvd: 0 0
L4 sent : 0 0
Buffers : 687 681 695 686 685 693
CPU loop: 516 526 560 523 525 566
Timers : 1352 5184
i
PMR:VE7PMR} Penny Mtn.6400 ft.
Solar System 3 watts
On Air Sept.3 '93
VE7EMS Dennis 564-9396
btext
PMR:VE7PMR} Penny Mtn. at 6400ft.-Serving the Robson Valley
b
PMR:VE7PMR} Goodbye.
*** DISCONNECTED [17-04-95 20:09:05]
```

Install

After contacting several helicopter companies while I was building the unit, I lucked out by running into Northwood Pulp & Timber, Ltd. They not only transported the unit to the top of the mountain but took three of us up and brought us back for free. The night before we set out on our journey, we loaded the node on the box of my pickup and tied it down, with the help of seven amateurs. We left the next morning and arrived at the bank of the Fraser River, seven miles from the site, right on time to meet the helicopter. Shorty VE7HRC, Randy VE7AMS, and I were transported up to the mountain. While the helicopter went back to get the unit, we looked for the spray-painted spot. It was gone! I had used environmentally safe paint. Uh-oh . . .

As the helicopter had the unit by now and would be back to the site in four minutes, we had to think fast. I looked around and made an educated guess concerning where I had made the path check in July, and stood on the spot just as the helicopter was coming over the ridge with the unit.

Successful landing! The weather was beautiful, about 70° F with just a slight breeze. We leveled the unit with the adjustable legs, unwrapped the protected solar panels, and mounted the initial 5/8" PVC-protected antenna.

We drove five lightning rods three feet down into the overburden and connected each leg of the structure to a rod. All the components inside were grounded separately to a fifth. A sixth ground rod was driven in at the peak, in hopes of attracting any nearby lightning strike to it, rather than the node. I then proceeded to paint the structure with tremclad rust paint.

Our two hours were now up and the helicopter was on its way back to get us. I fired up the node at 2:30 PM on September 3, 1993, and Frank VE7ENX in McBride was happily packeting to Prince George's BBS-VE7FG. We all jumped into the helicopter and left the site with our mission successfully completed.

Improvements

In October 1994, after Wayne VE7DUC redesigned an 18-foot, 6-dB commercial Fiberglas antenna for this operation and we acquired two additional 1,000-amp batteries, we had them airlifted to the site. Warren VE7DPG and I hiked up the mountain to install the X1J2 upgrade: the deviation, temperature, and voltage meters; and to open the squelch mode on-line before the snow hit. Otherwise, I would have to wait until late June of 1995 before it thawed enough to get back to the site.

The antenna and battery upgrade were necessary to drop the power to 3 watts and still get the same ERP. PMR also needed the additional capacity to support the new BBS that was now in McBride and all the forwarding it created.

We left the cabin wearing two pairs of long johns, rain clothes, mitts, and snowpacks. We were ready . . . or so we thought. Unfortunately, as we neared the summit the first snowfall of the year hit us with a vengeance. We were now in a full-blown blizzard with 40-mph howling winds and no place to hide, with only 30 feet of visibility! We persevered and mounted the antenna, hooked up the batteries and topped off their water levels, and installed the upgrades. The cordless drill died on us, as NiCds don't like cold; the butane soldering iron also died, as the butane wouldn't turn into gas. We worked around it though, closed the lid, and left without taking a picture. We just wanted to get the hell out of there! We slipped and slid our way down the slope to the cabin through the now 2 inches of snow, our bodies shaking and fingers numb, snow stinging our eyes as it was coming at us at 90 degrees. Hypothermia setting in? This hobby is no fun in those conditions, and I don't think Warren wants to go back to the site anytime soon. I'll stick to August visits myself from now on!

Operation of the PMR since October 1994 has been monitored remotely from the site. The lowest voltage recorded at B4 was 12.3 V, and it was -10° C inside the freezer when the valley temperature was -34° C. The node has been running for more than 5,000 hours on X1J2 software and has never been off the air!

My Gratitude

I thank all the amateurs who helped in this project in various ways, including Shorty VE7HRC and Randy VE7AMS, who were on the initial installation team that put the unit on the mountain, Warren VE7DPG, who almost froze to death with me, and anyone else I might have forgotten to mention.

I believe this project shows that if all amateurs work together, anything is possible. If anyone says to you something can't be done, well . . . remember there is no such thing in life as "can't." PMR is dedicated to God and to my family. ■

Number 6 on your Feedback card

19,200-Baud Packet

A simple way to do it.

By Alan Dewey, M.S., WB9JTK

Several articles and editorials have expressed the disappointment many amateurs feel regarding the lack of advances in amateur packet radio. When I first tried packet radio in 1987 we had lots of fun at 1,200 baud. Now, eight years later, just about everyone is still operating that same slow speed.

Simply Simplex

Even a 1,200-baud telephone line computer connection is much faster than 1,200-baud packet radio. This is because our 2 meter FM radios are, by necessity of economics, simplex communications devices. The stations at each end of the connection must take turns transmitting information and acknowledging the reception of that information. And when you factor in the frequency usage by others in your LAN (local area network) the effective bits-per-second (throughput) of your "connection" drops to even more pitiful levels. These pitiful rates of throughput further delay acceptance of many of the great uses of packet radio.

So why is all the packet out there running such slow speeds? Well, in order to keep the cost down, the packet terminal node controllers (TNC) that are so readily available, are designed to run on a "standard" VHF/UHF voice FM radio. This means that they will be limited to the available 3,000-Hz bandwidth of most FM communications radios.

Though today we can buy 14,400-bps (bit per second) modems for $89 at the local discount store, that technology is not applicable to amateur radio at this time. Although many manufacturers incorrectly state that their modem is "14,400 baud" it is, in fact, a 14,400-bit-per-second unit. This is accomplished by techniques which rely on the instantaneous phase of the signal having 32 or more possible meanings. If we try these techniques over our VHF/UHF FM radios, we will be very disappointed. Problems such as multipath and signal/noise are much greater "on the air" than on the "twisted pair."

High-Speed Difficulty

You may have heard how difficult it is to get 9,600-bps packet running correctly, that you should use a deviation meter, and often the modification of the radio is not easy. This is because 300-, 1,200-, 2,400-, and 9,600-bps packet systems use audio frequency shift keying (AFSK). Those systems use a "modem" to convert the data into audio signals which then modulate the frequency of the radio. At the receiving end, the discriminator will demodulate the analog frequency modulation of the RF carrier and output an audio signal which the modem then turns back into data. Sound complicated? It is. True FSK eliminates most of this process!

So the easy solution is to use a radio that is designed for the bandwidth appropriate to the speed, and use frequency shift keying of the carrier. It is much more difficult to try to cram a delicate AFSK high-baud signal through a "slow radio." (The Nyquist theorem limits a 3,000-Hz bandwidth channel, whether phone line or radio, to 1,500 baud.) Should we desire to operate packet radio at 19,200 baud, we need approximately 40 kHz bandwidth (for a modulation index of 1.0). On amateur bands 420 MHz and above, the FCC limits on bandwidth are extremely generous, even allowing double-sideband AM television (FSTV) which occupies 9 MHz of the band! And the ARRL bandplan allows for 100-kHz wide "channels" for just such uses as high-speed packet.

Radios for High Speed

Well, finally we are able to buy radios that are designed for the bandwidth required to transmit and receive higher speed packet "off the shelf." WD4NKZ and I have been operating 19,200-baud packet with this equipment for more than two years.

Kantronics introduced the D4-10 radio that was designed with this mode in mind. The radio has the required bandwidth, comes with 430.550 MHz installed and trimmed, and includes digital as well as analog interfaces. When using the "data" port of the radio, the modulation scheme is true FSK with frequency shift of 19,200 Hz total. We only need to mate the radio with a suitable packet controller, antenna, power supply, and coax to achieve our goal.

Our choice is the DRSI PC*Packet adapter type 1. Unlike an external TNC, the DRSI adapter plugs directly into your computer. This allows it to communicate directly to your computer data bus in parallel, 8 bits at a time. Compare this to an external TNC that must communicate with your computer in serial fashion. With an external unit communicating in serial fashion there is an added difficulty for the computer and the TNC in keeping "commands" separate from "data." If, however, your packet adapter is connected directly to the computer bus, you will not have this problem.

The DRSI packet adapter provides the "standard" 1,200-baud modem port, and an additional port settable from 110 to 38,400 baud. This allows us to operate both ports simultaneously, and the speeds are selected independently. Because the 1,200-baud port is operated and connected to your radio much the same way as all other 1,200-baud systems, this article will be confined to set-up and operation of 19,200-baud packet only.

Frequency Shift Keying

First note that for 19,200-baud FSK packet operation there is no modem. This mode uses true frequency shift keying of the RF carrier. This is done by transmitting on one of two distinct frequencies, depending on the instantaneous value of the input data stream. In a perfect world (and with enough receiver bandwidth), the receiver output would represent a nice neat square-wave data stream which could go directly to the packet disassembler. To be practical, the D4-10 includes a data-shaping circuit which makes nice, neat, binary voltages from the received signal. The signal is then directly interfaced to the packet controller. In fact, the interface that I have designed would be unnecessary if Kantronics had in fact built the D4-10 radio as a TTL-compatible unit.

Because the DRSI PC*Packet adapter type 1 can run up to 38,400 baud "out of the box," all that is needed is to convert the voltages from the DRSI packet adapter (RS-232 levels) to the voltage levels compatible with the D4-10 radio. And to allow for unattended operation, we add a time-out timer. (The timer prevents unnecessary interference to other users should your software lock up.)

Should you start to be confused by the remainder of this article, I recommend as good references on packet radio *Your Gateway to Packet Radio* and the *ARRL Handbook*.

What prevents us from plugging the DRSI unit directly into the Kantronics D4-10 radio is that, although the receive data (RXD), transmit data (TXD), and data carrier detect

Continued on page 18

19,200-Baud Packet *Continued from page 16*

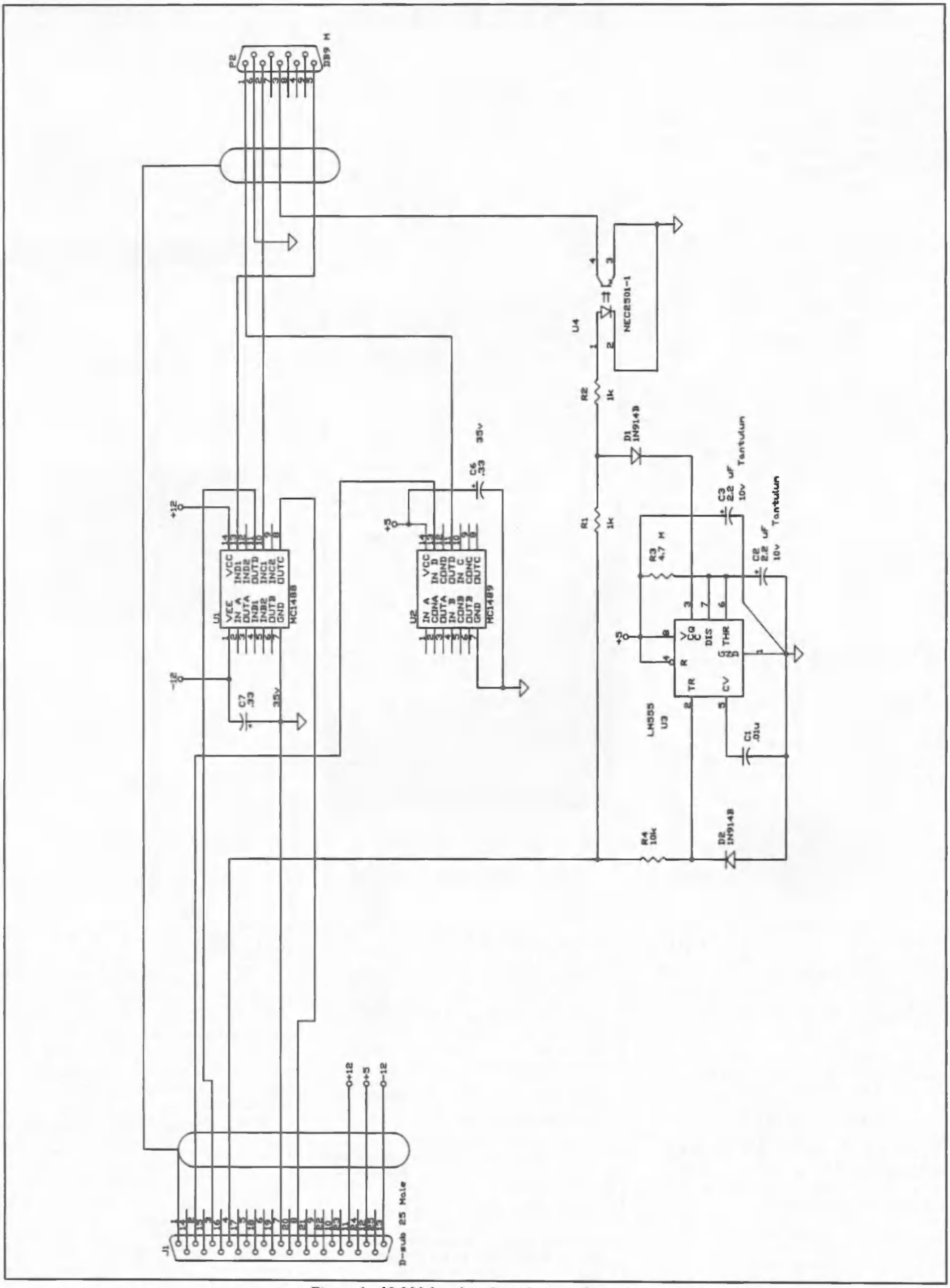


Figure 1. 19,200-baud packet adapter schematic.

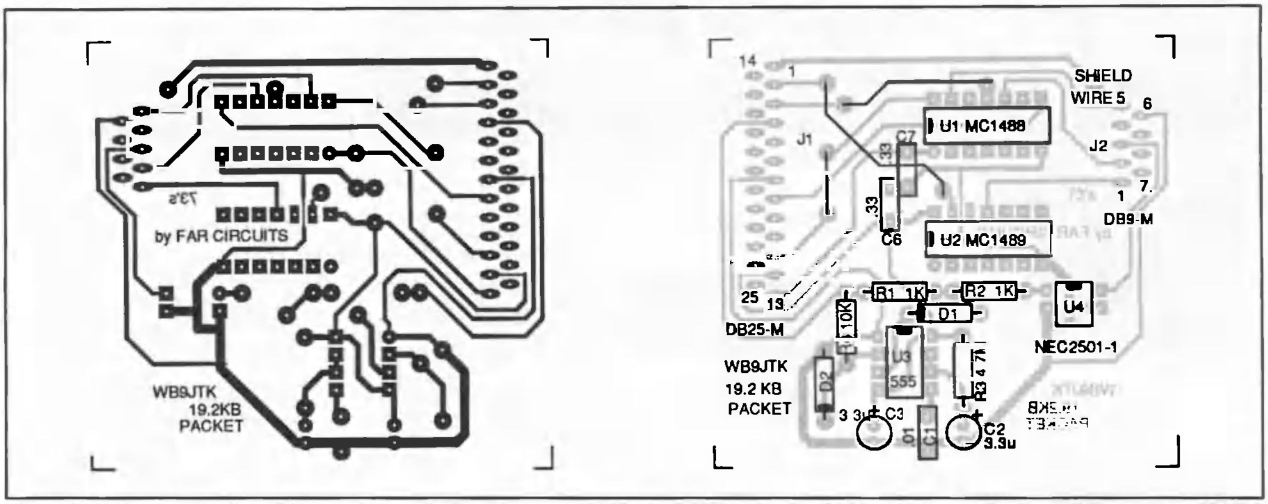


Figure 2. Printed circuit board layout. Pre-made boards are available for $6.00 cash plus $1.50 S&H per order from FAR Circuits, 18N640 Field Ct., Dundee, IL 60118.

(DCD—RF squelch in this case) lines are "TTL compatible" (0 and 5 VDC), the RTS (push-to-talk) line operates with 0- and +12-volt levels! The DRSI PC*Packet adapter can be operated at RS-232 or TTL levels. But neither case is compatible with the PTT line of the D4-10.

I looked at many possibilities to get these two units to work together. Unless we are ready to modify a new radio under warranty, an external solution is required. The method I show here requires no modifications to any purchased item.

Getting It Together

My choice for this solution was to build a small box housing the circuit, a 1-meter cable (the interface is placed near the middle), and the appropriate D-sub connectors. Within the box is one chip to convert RS-232 levels to TTL (signals from the DRSI board to the D4-10), one chip to convert TTL level signals to RS-232 (signals from the D4-10 to the DRSI board), one opto-isolator chip, and an NE555 timer for the 12-volt PTT line of the D4-10.

The accompanying schematic shows how simple the interface is. I built several up on perf-board in an hour. This project does not need to look professional to provide professional results. Placement of components is not important. My interface is built in a plastic box and I have never experienced EMI problems, even during high-power CW HF operation adjacent to my packet system. For those who desire an easier route to a professional looking unit, a kit including circuit board and board-mounted components is available.

The circuit is rather simple. J1 is a 25-pin connector that plugs into the DRSI unit (which is installed in your computer). The 9-pin connector, J2, connects to the radio. Power for the circuitry comes from the DRSI packet adapter itself via three user-installed jumpers. The DRSI manual gives detailed instructions for installation of these jumpers. U1 is a TTL-to-RS-232 converter chip. This chip converts the 0- and 5-volt DCD and RXD signals from the radio to -12/+12-volt levels for the DRSI unit. U2 does the opposite of U1. It converts the -12/+12-volt TXD signal from the DRSI unit to a 0- and 5-volt signal level for the radio.

Next look at U4, R1, and R2. The RTS (request to send) from the DRSI unit is also a -12/+12-volt signal. When RTS is +12 volts, the LED in U4 is turned on, which turns on the transistor, which pulls the PTT line of the radio to ground, which turns on the transmitter. This voltage conversion could be accomplished with a few transistors, but by using an opto-isolator we have a quick solution.

U3 is a common 555 timer. After about six seconds the output of U3 will pull any signal at R1-R2 to ground, which will prevent U4 from keying the transmitter. U3 is reset every time RTS from the DRSI unit returns low. The values shown would allow you to set your PACLEN to about 12,000 bytes, a packet length that would take just over six seconds at 19,200 baud.

A complete parts list is shown in Table 1. Equivalent parts are also available at Radio Shack. Please note that none of the part values are critical, so you may substitute available values that are close. A complete kit, which includes ready-to-use printed circuit board, 1 meter of 8-conductor shielded cable, connectors and connector shells, and all board-mounted components, is available from Solid State Systems, 12807 J West Hillsborough, Tampa, Florida, 33635 for $13.95 plus $2.00 shipping & handling (FL residents add tax on $13.95)

We have built two interfaces which lack U1 and U2. This can be done by changing the DRSI packet adapter to a TTL-compatible unit as shown in the user manual. However, by using the circuit shown, the DRSI unit remains operating with RS-232 voltages so that you can quickly change to 300-baud HF by simply plugging in the HF modem instead of this interface, a move that would not be so easy if the DRSI unit were converted to "TTL" voltages.

Operation

Operating 19,200-baud packet radio with this setup is fairly straightforward. I suggest that those of you that have not used the DRSI PC*Packet Adapter before use the included software, PC-TNC, to start with. Set FRACK to 1 second, RESPTIME to 10 ms, TXDelay to 7 (70 ms), and HBaud to 6 (which corresponds to 19,200 baud). If use of the frequency is light in your area, set PERSIST to 64. These settings should provide immediate results. I recommend that you start in this manner to ensure that the rest of the system is working. You may find some other software that will not work satisfactorily at these speeds. Also, do not attempt to run these speeds under Windows. I know of no one who has been successful.

Once you have tried 19,200-baud packet, you will not find yourself operating 1,200-baud again very often. However, since all DRSI PC*Packet adapters are dual-port devices, you will maintain compatibility with those still on 1,200-baud AFSK by simply connecting the appropriate radio (probably 2 meter FM) to the other port of the adapter. Conversely, with the proper settings of your software, hams with only 1,200-baud equipment can use your dual-port station to make connections with other 19,200-baud packeteers (which now enables you to operate as a multi-frequency node or gateway). The advantages of the higher speeds will become addictive when you discover that you can exchange very large computer files very quickly. With the change in FCC regulations concerning "business" use of amateur radio, it is now legal to exchange shareware programs as well as freeware. Also, these higher speeds will allow remote access to large databases. Things happen so quickly at 19,200 baud that you can only describe it as astonishing.

Great Perfomance for a Few More Bucks

When you compare the cost of 1,200 baud to 19,200 baud you can see that there really is very little difference in price, but a very large difference in performance. And if you compare the total cost (plus work) involved to operate 9,600-baud systems, you will see that 19,200-baud FSK is the clear winner. The

typical amateur may not be a pioneer in digital communications, but he should certainly not be an antique. If you implement the method shown in this article, you will find that high-speed packet is possible without any exotic test equipment or modification of equipment.

I hope to show to the amateur community that high-speed packet radio is easily accomplished today with very little work. Note that I have not even covered the subject of on-the-fly data compression, which could raise throughput to speeds that will allow for uses of packet radio that are only dreams today. I wonder if, within a year, some ambitious ham might write a TSR which would allow us to play interactive computer games over packet radio. How long will it be before we are operating digital voice networks or voice mail? When the cost of 19,200 baud is compared to 1,200 baud there is no excuse anymore.

Table 1. Bill Of Materials

Item	Quantity	Reference	Part	
1	1	C1	0.01 µF	Digi-Key P4513
2	2	C2, C3	2.2 µF	Digi-Key P2022
3	2	C6, C7	0.33 µF	Digi-Key P2056
4	2	D2, D1	1N914B	Digi-Key 1N914BPH
5	1	J1	DB-25 Male	Digi-Key 225M
6	1	P2	DB-9 Male	Digi-Key 209M
7	2	R2, R1	1 k	Digi-Key 1kQ
8	1	R3	4.7 M	Digi-Key 4.7MQ
9	1	R4	10 k	Digi-Key 10kQ
10	1	U1	MC1488	Digi-Key DS1488N
11	1	U2	MC1489	Digi-Key DS1489N
12	1	U3	NE555N	Digi-Key NE555N
13	1	U4	NEC2501-1	Digi-Key PS2501-1NEC
14	1	3', 8-cond. cable	Carol C0744	Digi-8-Key W408-X
15	1		D-25 hood	Digi-Key 925GM
16	1		D-9 hood	Digi-Key 909GM

Notes

1. Use caution when adjusting the "squelch/DCD" adjustment on the D4-10. Should your "diddle stick" go too far into the unit, the 12-volt supply will be shorted to the 5-volt supply and the transceiver will be definitely damaged. It happened to me.

2. TXDelay. Although the ads say you can run a TXDelay as short as 30 milliseconds, we found that 60 milliseconds is much better. So we run 70 ms to be sure.

3. FRACK. I prefer MSYS BBS software, which only allows setting the FRame ACKnowledge timer in 1-second increments. One second is too long and zero seconds is too short. So, we use 1 second.

4. RF Path. You need a much better RF path for 19,200-baud packet than you do for 1,200-baud packet. At these speeds and these wavelengths, multipath is a real problem. Also, reflection of the RF by trees and plants is much greater than at 2 meters.

5. Software. If you are running a slow computer (8088 or so) and a BBS, you might find that the thing will not be any faster at 19,200 than it is at 1,200.

6. Use TTL port of the D4-10. Set the front panel switches to wide, and the "sat" switch should be off.

7. When you configure your software, be sure that you utilize the DCD feature of the radio. Though some software allows you to use "software DCD," this only adds extra work to your computer and will require longer TXDelays from the transmitting station.

8. It is fun to listen to your 19,200-baud packets "fly" by plugging a speaker into the connector provided on the radio. Do not be surprised that the packets sound like nothing but noise after the initial high-pitched tone during TXDelay. The tone is the result of the non-return-to-zero modulation scheme employed in the AX.25 standard. During the TXDelay, you hear only a single tone, which is the periodic signal that the receiving equipment is using to synchronize the data clock. This is followed by the addressing and data bits, and due to their "random" nature, will result in a signal that contains many different frequencies, hence the noise sound.

RF Speech Processing

How to get an extra 6 to 9 dB of talk power on SSB.

by Greg Whiter VK3CA

It has been verified, through extensive tests, that the ordinary voice contains high-amplitude peaks which are about 14 dB greater[1] than the average level, and furthermore that a large portion of intelligence is contained in the low-amplitude components. It is also recognized that voice communication systems are often peak-power limited. For example, most single-sideband transceivers will output 100 watts of peak power (Peak Envelope Power) before they either flat-top and distort, or their AL systems cut in, even though their average (or *talk power*) output on voice at this time may only be down around 15 to 25 watts. From these facts one infers that the natural voice may not provide maximum utilization of the equipment. Put another way, the talk power is not as great as it could be if the peak-to-average ratio were not so high. If the average can be elevated without overloading on peaks, the weaker components of the voice become more prominent, Figure 1 illustrates this. The result is that on a noisy or cluttered channel, a higher level of *articulation* is achieved.

In order to reduce the peak-to-average ratio, it is necessary to modify the signal waveform. This inevitably leads to distortion of the voice signal. This distortion, in turn, reduces the articulation. From all of this it may be concluded that the best method of speech processing is one that gives the greatest talk power and least distortion. Such a method is RF speech processing.

Which . . . and Why?

In comparing the various methods of speech enhancement we first come to a common form used particularly by the CB fraternity—the so-called "power microphone." The cheaper units found on the market are generally nothing more than microphones with audio amplifiers built in, and provide very little improvement in performance over the radio's standard microphone. In fact, in many cases they will reduce speech articulation by introducing additional distortion and room echo.

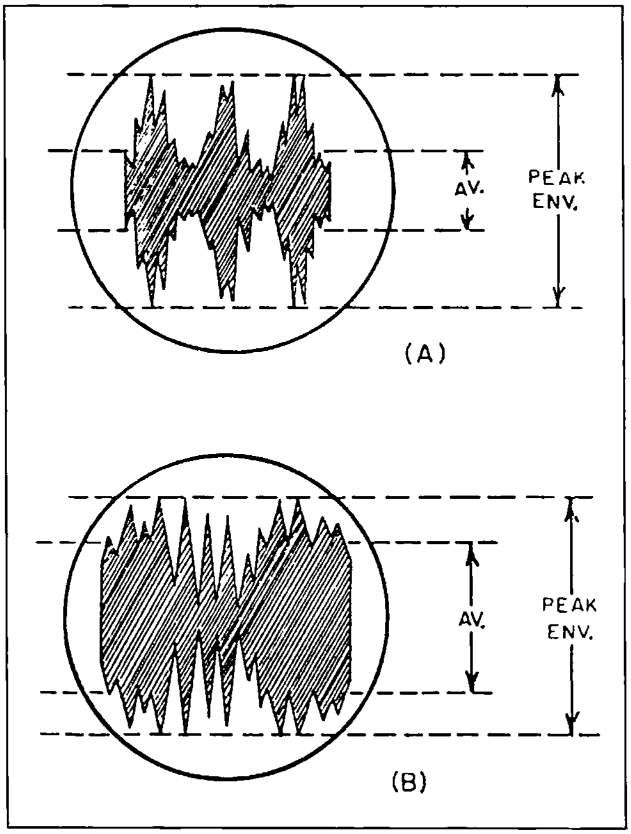


Figure 1A. A typical unprocessed SSB voice-modulated signal might have an RF envelope of the nature shown, where the amplitude is plotted as a function of time.
Figure 1B. The envelope after speech processing shows an increase in average power for the same peak power; that is, a reduction in average-to-peak ratio resulting in better articulation at the receiver.

The better quality power microphone does incorporate audio amplification, audio peak clipping, and audio filtering. When used correctly it can provide up to 4 dB improvement in articulation (or signal-to-noise ratio) over a standard microphone on a radio that is driven to the point of ALC operation. However, to achieve this, its peak clipping level needs to be up around 20 dB. As an aside, *audio compression alone* can give only about 1 dB improvement in signal-to-noise ratio under these circumstances. On the other hand, a well designed RF speech processor which incorporates compression, RF clipping, and RF filtering can give 8 to 10 dB[2] improvement in received signal articulation when set up to 20 dB of clipping.

One may well ask why there is such a big difference between the performance of audio processing and RF speech processing systems. The main reason for this is that any form of peak signal clipping, by its very nature, introduces distortion products to the waveform. The distortion comes mainly in the form of harmonics generated from the fundamental signal. To maintain the speech articulation at a high level, these harmonics must be removed.

In RF speech processors the unwanted harmonics lie a long way away from the desired signal's frequency and are easily removed using quality RF filters. Unfortunately, in audio clipping systems a number of harmonics lie within the desired audio band and can't simply be removed, leaving the signal with a high level of distortion and consequent reduced articulation.

For example, it is generally recognized that the minimum bandwidth required for an SSB voice communication system is

300 Hz to 2,700 Hz (contrary to this general rule however, most SSB CB radios have bandwidths of 300 Hz to 4,500 Hz). The presence of audio frequencies between 300 Hz and 1,300 Hz are important for good articulation. The second harmonic of 300 Hz is 600 Hz, while that of 1,300 Hz is 2,600 Hz. Both of these frequencies, and those between them, lie within the desired voice band and can't be removed without affecting the desired signal.

Processing, RF-Style

What constitutes a good quality standalone RF speech processor? If an RF speech processor is to perform its task properly, it should contain the following subsections: an audio compressor, a single-sideband generator, an RF peak clipper, an RF bandpass filter, and a product detector. The function of each of these components will be discussed separately below. For additional details, see also the block diagram in Figure 2.

"In comparing the various methods of speech enhancement we first come to a common form used particularly by the CB fraternity—the so-called 'power microphone.'"

An audio *level compressor* should be incorporated so that the RF stages, particularly the peak clipper, are supplied with a constant average signal level. It has been found in practice that compression in the order of 20 dB is required in this stage.

The *single-sideband generator* follows the audio compressor in order to produce an RF waveform suitable for peak clipping. It consists of a carrier oscillator, balanced modulator, and bandpass filter. The waveform it presents to the peak clipping stage is that of a single-sideband suppressed-carrier signal.

Additional linear RF amplification and amplitude peak clipping are the tasks performed by the *RF peak clipper.* For maximum increase in articulation of the received signal, approximately 20 dB of clipping is required. The waveform after clipping is that of a very distorted signal made up of fundamental frequencies and many high-amplitude harmonics. It is then applied to an *RF bandpass filter* of the same type used in the single-sideband generator stage. The filter output waveform, now virtually free of distortion, is ready to be put to use in the next stage of the RF speech processor.

The final stage, a *product detector,* converts the processed RF signal back to audio frequencies. It consists of a carrier generator (sometimes known as a beat frequency oscillator, or BFO) and a balanced demodulator. Audio output from the product detector, now fully processed, is level-adjusted and available for application to the microphone input of a radio.

Because very high gains are used within an RF speech processor, both in the audio compression and RF clipping stages, the designer must be well aware of the possibility of RF feedback problems occurring. A properly designed unit will have all external connections filtered in an effort to guard against this.

In concluding, if you would like a bigger signal, and your current radio setup is already running at the legal peak power limit, or you just can't afford a big linear amplifier, consider RF speech processing as an option. It is a very appropriate and clean method of increasing power legally for minimum outlay.

For further information, I can be reached at: Greg Whiter VK3CA, c/o GFS Electronics, P.O. Box 97, Mitcham, Victoria, 3132, Australia; 03-873-3777, fax: 03-872-4550.

References:

1. Sabin, "RF Clippers for SSB," *QST,* July 1967.
2. Squires & Clegg, "Speech Clipping for SSB," *QST,* July 1964.

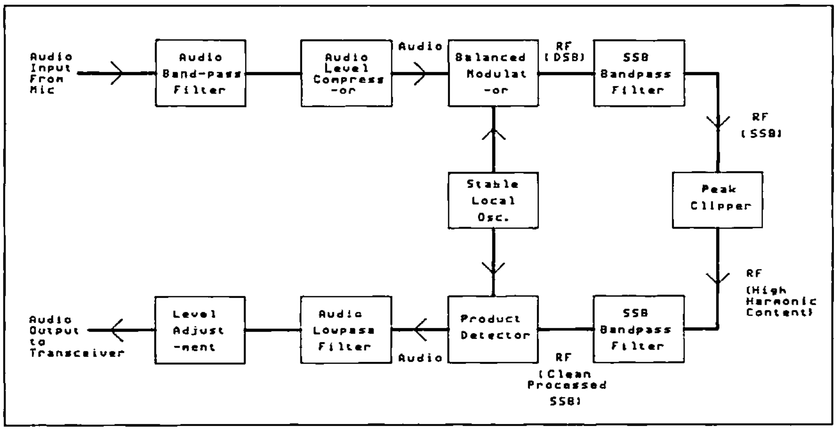


Figure 2. Block diagram for an RF speech processor typical of the type described in the text.

Working the Final Frontier

Ideas for a fun and easy ham space program.

by Bill Meara N2CQR/HI8

Here are some ideas on how your average ham, armed only with fairly standard equipment, can get involved with space communications without going over the technological deep end or spending NASA-like megabucks. For the last year or so I've been dabbling in satellite operations. Using ridiculously low-tech gear, I've been surprised by the amount of educational fun that I've had with my little space program; my involvement in amateur space communication has rekindled some of the excitement that I felt as a ten-year-old kid watching the Apollo moon shots on TV.

Getting Started

A sensible first step in a ham space program is acquiring some simple satellite-tracking software. Without an easy, sure-fire method of locating satellites and predicting when they will be within range, trying to work the satellites can be a frustrating experience involving much static and few signals.

The satellite tracking software is essentially a mathematical program that displays on a map of the earth the positions of objects in orbit. The characteristics of the particular orbits are described by what is known as their "Keplerian elements," or "Keps" for short. After you get the satellite-tracking software installed in your computer, you input the Keps (available from a variety of sources) for the satellite you are interested in, and suddenly you have a screen showing the precise locations of satellites of interest. Just tracking the satellites is a lot of fun. I thought it was neat to be able to look at my screen and know that at that moment a satellite was zooming through the night sky over Tokyo!

AMSAT is a great source of satellite-tracking software, and by joining this organization you will be supporting the Amateur Satellite program. For those readers who are not computer experts or who have relatively unsophisticated machines (I use a 286 machine with CGA graphics), something simple like the ORBITS II program will do the trick. You can get the Keps right out of the *AMSAT Journal*, via the packet bulletin boards, or via the online computer networks (I use CompuServe). One tip: Consult the *Amateur Satellite Experimenter's Handbook* from ARRL and learn what the various numbers in the Keps mean. You'll learn a little bit about orbital mechanics, and it will make your satellite ops more meaningful.

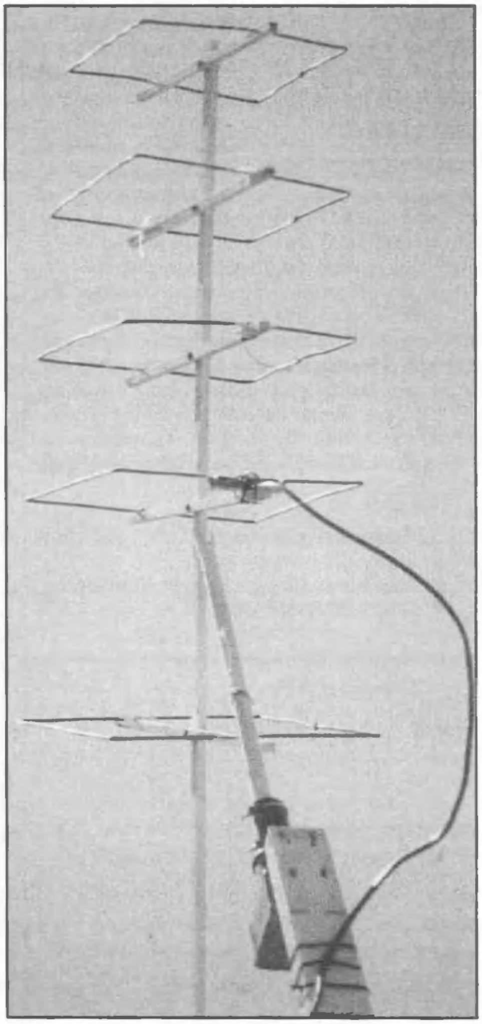


Photo A. The home-brew 5-element quad at N2CQR/HI8, poised for contact with RØMIR aboard Russian Space Station Mir.

One other hint: Make sure you have your computer software clock on the correct UTC date and time. Incorrect settings are a frequent cause for "I can't hear the satellite" complaints. You may be on Eastern Daylight Time, but the bird is on Universal Coordinated Time!

All the old ham literature advises newcomers to spend some time listening before they first try to get on the air, or before they first experiment with a new mode. This is a good idea even in the space age. Before you try to have some QSOs, spend some time trying to listen for the satellites. You'll have a lot of fun picking up signals from space, you'll get more comfortable with the software, and you'll be preparing yourself for that first big satellite contact.

Here are some good candidates for satellite "easy listening":

RS-10/11, RS-12/13 and RS-15: These Russian-made ham satellites put out very strong downlink signals on the 10 meter band. (See the August 1993 and February 1994 editions of *QST* for details on RS-10 and RS-12; see March 1995 *73* for information on RS-15.) You really can't miss these satellites, even if you are using simple wire antennas. When your software shows the bird approaching your horizon, start tuning around the beacon frequencies. You'll hear the CW beacons first. When the beacon is strong, tune through the passband and you'll hear SSB and CW QSOs. Listening tip: Copy the CW telemetry and later consult the *Satellite Experimenter's Handbook* to decode the data (by hand). You'll be able to learn about the satellite's temperature, battery status, power output and other "fun facts"!

DOVE: Here is another good target for "easy listening." Sponsored by Brazilian hams, DOVE is a nine-inch cube that circles the globe, sending out

telemetry and messages of international goodwill. At times, DOVE's voice synthesizer is activated and on your 2 meter FM receiver you can hear it say (in English) "Hi! This is Dove in Space!" ("Hi" represents a bit of ham satellite tradition: The first OSCAR transmitted a continuous stream of CW "Hi's.") Unlike other hamsats, DOVE's digital messages are easily copied on an ordinary 2 meter packet station. Here's a trick for capturing signals from DOVE (without losing sleep!): Leave your packet station on overnight with the receiver tuned to 145.825, and leave the computer's storage buffer on. In the morning you're likely to find messages from DOVE on your screen. You can also easily copy DOVE's signal on an HT. Just set your receiver to 145.825; within 12 hours DOVE's packet signals will break squelch.

Photo B. See any complicated NASA-type gear here? Nope! Author N2CQR/HI8's satellite ground station is simple . . . but darned effective!

Talk Back!

Once you get the hang of the software and have some listening time under your belt, its time for a QSO! I'd heard that a ham's first satellite QSO is as exciting as his very first contact or first DX: I can confirm that—at least in my case—this is true. I was really amazed the first time I heard my own signal coming back from a spacecraft, and even more excited when I heard someone calling me "through the bird."

RS-10 and RS-12 are excellent vehicles for a ham looking for his or her first satellite contact. RS-15 is in a higher orbit and thus provides better DX opportunities, but the higher orbit might make it a bit more difficult for a newcomer to use.

Don't worry too much about Doppler shift. When I was getting started, the literature sometimes made Doppler shift (the apparent change in frequency caused by the satellite's motion) sound like a formidable obstacle. You will notice the Doppler shift, and it is definitely a force to be reckoned with, but don't get wrapped around the axle trying to calculate how far frequencies will be shifting! Satellite operators are a flexible bunch, and most tune around a little to find the signal of a ham whose signal is being shifted by the forces of physics. I've found that dealing with Doppler is very much like dealing with drifting VFOs in the old days (or dealing with my HT-37 when it's cold).

"I heard one of the astronauts comment, 'We're now passing over the Southern tip of South America.' Eureka! Keplerians confirmed! I felt like I was sitting in mission control!"

Use RS-10! Because of its easily accessible HF uplink and downlink, RS-12/13 is getting a lot of use, but RS-10/11 is relatively neglected, probably because of its VHF (2 meter) uplink. At the risk of encouraging a lot of chirpy CW, let me repeat a suggestion that allowed me to get on RS-10 with ease: Use a 2 meter FM transceiver for a CW uplink to RS-10. I tried this by simply using the push-to-talk button as a telegraph key, but my signal was so chirpy that I couldn't stand listening to my own signal! In pursuit of a cleaner tone, I opened up my old Yaesu Memorizer transceiver, found the positive collector voltage line going to the driver and final, and inserted a little telegraph key jack. I closed the push-to-talk circuit at the mike jack with a little alligator clip and—presto!—I had a CW signal on 2 meters that allowed me to make plenty of contacts (using a "coathanger ground plane"). The signal isn't the prettiest CW signal on the bands, but I don't think it causes any interference to other amateurs. I found QSOs using this modified rig particularly satisfying: That 2 meter Yaesu FM rig was never intended to work CW DX. Also, doing that little modification made the rig (for me) less of an "appliance"!

This little modification also gave me the capability of working the new RS-15 satellite (2 meters up, 10 meters down) but I haven't had as much success with this bird as I had with RS-10. My modified Yaesu just doesn't seem to get enough signal up to the higher-orbit RS-15.

One of the neatest features of the Russian "Easysats" RS-10/11 and RS-12/13 are their onboard robots. It took me a bit of trying, but I was eventually able to work the robots of both the RS-10/11 and RS-12/13. Some observations: It seems that if more than one station is trying to use the robot at the same time, the machine sort of "locks up." Thus, you might want to wait for a pass in the wee hours of the morning. (From HI8, I just waited for a pass that would have most of the footprint over the relatively unpopulated eastern Caribbean). Also, the robots are looking for 20-wpm CW. They will sometimes tell you to speed up or slow down if you are not at the right speed. You can do it with a straight key, but this is sort of "pushing the envelope." The RS robots are FB hams. They give you a QSO number, say thank you, wish you 73, and QSL (via DF4XW). Talk about "working a new one"!

Moving Higher

After you play with the fast-moving, low-orbit birds for a while, the prospect of finding a satellite that will stay overhead for a long period and will provide the opportunity for real, long-range DX is very appealing. When I added the Keplerian elements for the OSCAR 10 and OSCAR 13 satellites to my ORBITS II program, I was intrigued. Compared to the low-orbit birds mentioned above, these elliptical orbit satellites have enormous footprints and linger overhead for hours as they rise to and fall from their very high apogees. In addition to the prospects for working some interesting terrestrial DX, I was attracted to the possibility of receiving signals from a device 24,000 miles out in space.

I bought a little Hamtronics downconverter to allow me to listen to the 2 meter (SSB and CW) downlink signals from OSCARs 10 and 13 on my old Drake receiver. With these satellites so far out in space, the little "coathanger ground plane" that I'd been using on 2 meters wouldn't provide enough gain. Long-time satellite enthusiast Pericles Perdomo HI8P showed me a June, 1990, edition of *73* magazine that contains

an article on an antenna called "The Ray Gun." Using small copper tubing acquired from a refrigerator maintenance shop and some scrap wood from a local lumber yard, I soon had a five-element, 2 meter quad and was listening to OSCAR 10 and OSCAR 13! I kept the antenna at a fixed elevation of about 45 degrees so I didn't have to deal with the additional complication of an elevation rotor. Listening to the DX on these high-orbit birds provides plenty of incentive to build a 70 cm transmit system. The five-element, 2 meter quad also proved very useful as a transmit antenna for RS-10 and RS-15 operations (in lieu of the coathangers!).

Working Manned Spacecraft

The Russian Space Station *Mir* and the U.S. Space Shuttle provide additional challenges for hams who are not satisfied with mere terrestrial contacts. Both the *Mir* and the Shuttle have been active on 2 meter packet and 2 meter FM voice. As you can imagine, competition for contacts is intense, but receiving signals from these spacecraft is easy and at least half the fun of making contact. Here in the Dominican Republic, English doesn't normally come out of my 2 meter FM rig's speaker, but during a recent Shuttle mission Ron Parise WA4SIR broke squelch in Santo Domingo from the Space Shuttle!

"I had one of the most exciting contacts of my life when U.S. astronaut Norm Thagard, aboard the* Mir*, came back to my 2 meter FM call."

In April of 1995, I had one of the most exciting contacts of my life when U.S. astronaut Norm Thagard, aboard the *Mir*, came back to my 2 meter FM call. Norm is a bit of a "rag chewer," so I was treated to a few minutes of conversation with an astronaut in space!

Unlike all the satellites mentioned earlier, with the manned spacecraft you have to try to update your Keplerian elements frequently. On both the *Mir* and the Shuttle, rockets are fired and orbital characteristics change from time to time; out-of-date Keps could give you false information on the spacecraft location.

During Shuttle missions, the voice communication between the astronauts and the ground controllers is retransmitted on the ham bands by the Goddard Space Center Ham Radio Club (3,860, 7,185, 14,295, 21,395, and 28,650 kHz). When I first started listening for the Shuttle, I wasn't quite sure whether I had loaded the correct Keplerians into my computer. As I was working around the shack, I had my HF receiver tuned to the retransmission frequency, and I had my computer running the satellite tracking program. Just as my computer showed the Shuttle passing over the southern tip of Chile and Argentina, I heard one of the astronauts comment, "We're now passing over the Southern tip of South America." Eureka! Keplerians confirmed! I felt like I was sitting in mission control!

If you really want to feel that you're "in touch" with the Space program, there is yet another use for the tracking software: You can use it to set up an "eyeball contact" with the birds! Both the Shuttle and the *Mir* are big enough and low enough to be seen with the naked eye. Consult your computer for a pass that will have the spacecraft over your horizon within an hour or so after dusk, or before dawn. In this way the spacecraft will be illuminated by sunlight on-high. Armed with your orbital data, you'll know exactly when and where it should appear. I've seen the *Mir*, the Hubble Space Telescope, and various shuttles many times. These big spacecraft are so bright that they are referred to as "flying Venuses" by the satellite tracking community. I don't know if they give out QSLs for signals received in the "visible light" band!

Be careful, because space communication is addictive and is likely to lead you into other closely related and time-consuming pursuits. An astronomical telescope has joined my radio gear in a constant attack on my sleep time. I've also noticed that those enormous Earth-Moon-Earth antennas that once seemed beyond the pale are starting to look interesting and do-able. I'm looking into radio astronomy . . .

Good luck with your space program. The sky's the limit. May the Force be with you. Live long and prosper!

Single-Chip Identifier

A simple, compact identifier for foxhunting and beacon operation.

by Breckinridge S. Smith K4CHE

Here's a very small identifier circuit for your latest miniature fox box, beacon, balloon flight, or basic repeater. It's a *timer and an ID circuit,* all on an economical 18-pin chip, with options for keying outputs, speed, and time. I stumbled upon a CW IDer ad by HCE of Bellefonte, Pennsylvania, and immediately ordered a couple of these chips, with my callsign programmed.

The chip is one-time programmable, so you have to be specific on the exact length and content you want for the identifier message. I chose a message length of 20 seconds for foxhunting, with a series of V's preceding and following my callsign (for example: "V V V K4CHE V V V"). Repeater operations would just have a standard callsign programmed, followed by "/R" and perhaps an abbreviated location, etc. A constant carrier with an identification in the middle is also available. Again, when ordering your chip, be very specific as to content and length.

The programmed IC (Micro Chip PIC16C54RCI) arrived several days later, complete with an external three-pin timing resonator. The schematic shown in Figure 1 was furnished in the instruction sheet from HCE. My contribution was to give suggestions to HCE on additional timing programming, configurations, and adding bypass caps.

Circuit Options

HCE has crammed several options into the chip's 18-pin package. All are selected by activating a high or low on designated pins. CW speeds are 10, 20, 30, and 40 wpm, and use pins 8 and 9. Off-period timing is one, three, 10, and 30 minutes, and uses pins 10 and 11. The standard chip configuration has a push-to-talk output which goes high on pin 6 (PTT) and can be used to key a small 2N222 transistor.

Pin 7 (test) of the circuit supplies a test feature of the identifier, so you don't have to wait for the off-timing period to expire in order to hear the CW tones to adjust audio levels, etc. The identifier transmit "on" period can be of varying lengths, and its timing is separate from the "off" periods, which are four programmed static values and cannot be changed.

When ordering your chips, you must specify if you want an additional keying output available to key your beacon/fox in CW mode. You can have the standard CW audio tones and, if you specify, you can have a TTL keying output which goes high on each code dot and dash segment. When

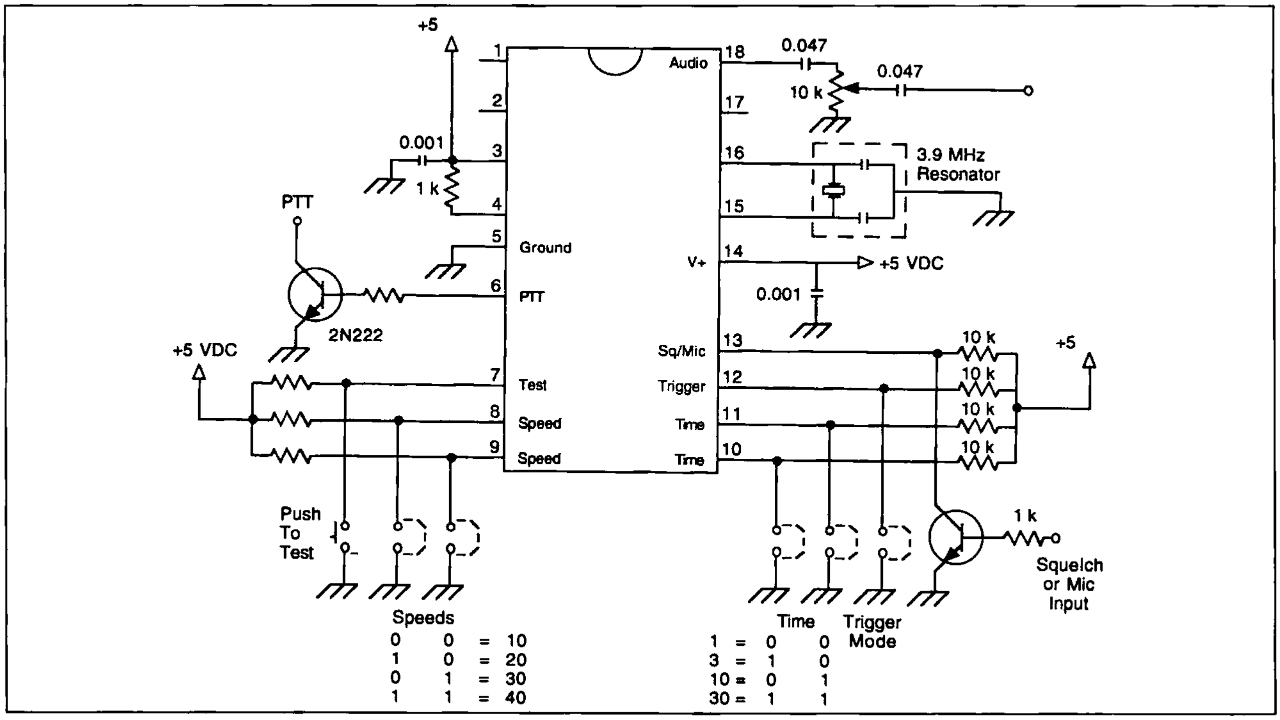


Figure 1. IDer schematic.

ordering your chip, if you choose the TTL keying option you will lose the pin 7 (test) capability, as this port on the chip will be designated as the keyed TTL output. According to Gregg WA3WNE of HCE, pin 7, when configured for a TTL output, can sink quite a bit of current, up to 25 milliamperes, but a keying transistor is recommended.

Construction

During construction, be sure to either ground all selection pins or tie them to +5 volts—don't leave any selections floating. The tiny resonator circuit furnished has three pins: The outside pins are tied to pins 15 and 16 of IC1; the center pin is grounded. The circuit is so simple that I used point-to-point wiring on a Radio Shack circuit board. A really small package can be constructed using "dead bug" mounting of the chip and soldering directly to the pins. As the chip is a CMOS device, use care when handling—ground yourself, etc., prior to handling the chip. However, I did abuse four of these little chips for over a week, letting them roam around my workbench area, and didn't experience any problems with static electricity or anything else.

"During construction, be sure to either ground all selection pins or tie them to +5 volts—don't leave any selections floating."

During construction I am sure you will try several different configurations on your breadboard, so don't forget to completely power down the chip to allow it to initialize and read its new configuration. As per HCE instructions, you may "tie pins 8 through 12 to ground or +5 volts as needed and eliminate any resistors." As with any logic circuit, regulation of the +5 volts is recommended with a 5-volt regulator chip.

Testing

After wiring the resonator circuit, I found approximately 1 volt peak-to-peak on pin 15, indicating that the clock was running, and the frequency, without any compensation, was approximately 3.987 kHz. My chips from HCE were programmed for a "center frequency of 3.950," to ensure staying within limits when using the 10-minute identification feature. Since the clock runs slightly faster than the "programmed frequency," this makes the one-minute period around 59 seconds. With a 5- to 15-pF variable capacitor connected from pin 15 to ground, I was able to lower the frequency by 10 kHz. However, this cap is not necessary to make the resonator circuit oscillate.

Pin 18 supplies approximately 8 volts peak-to-peak into my high impedance microphone circuit, so the 10k pot may be necessary to adjust the audio levels. One nice thing about the high peak-to-peak audio voltages is that they will easily power a simple varactor modulator circuit.

During repetitious fox box/beacon identification operations, don't forget to tie pin 12 (trigger) of the IC to ground. If you preposition a repeating fox box out with a delay power-on timer, the chip program has no problem starting up from a power-off state and will start its operation first with the "off" period, followed by the identification "on" period, and then start repeating the sequence.

During identification requirements other than a fox box or beacon, squelch gate keying or push-to-talk input keying can be used by tying pin 12 (trigger) high with 5 volts, and using an input on pin 13 (squelch/mike input). Further squelch gate or PTT keying during a brief transmission will not create another ID when using pin 13, as the chip is programmed to start only after the prescribed time period has elapsed. Identification on the beginning of each transmission, regardless of timing, is available by grounding pin 7 (test), leaving pin 12 (trigger) high, and then inputting on pin 13.

Small and Strange

Now you can have a really small low-current fox box package, complete with IDer. Using the TTL output, you can send straight CW, which sounds very strange but is still detectable on FM and provides a challenge to the hunters. The TTL output option for the port on pin 7 is perfect for CW keying of one of WA4ADG's small beacon transmitters (*73*, July 1990 and August 1990). If you want to hear something really strange during your foxhunt, feed audio from pin 18 into the audio input of a small transmitter, and at the same time, key the transmitter on and off CW-style using the TTL option. In the ol' days we called it "modulated CW."

Parts List

Qty.	Part Description
1	PIC16C54RCI (programmed by HCE)
3	1k resistor
7	10k resistor
2	0.001 µF capacitor
2	0.047 µF capacitor
1	10k pot
1	3.9 MHz resonator (furnished by HCE)
1	Push-to-test switch
1	Perf board

Note: The programmed IDer chip and its resonator are available from HCE, 717 N. Allegheny St., Bellefonte, PA 16823. Phone orders: 1-800-544-8450. Price is $11.95 plus $3 S/H.

Radios, Telephones, and the Amateur

Who's the culprit in telephone interference: the RF station or the telephone?

by Glen E. Zook W5UOJ

Virtually every amateur radio operator, at one time or another, has been plagued with telephone interference, either at his own home or at that of a neighbor. With the breakup of the Bell System, and the forthcoming cheap telephones from all directions, the problems of amateur stations (and, for that matter, all sorts of other radio stations) interfering with telephones has become a national problem.

Although not generally known among the amateur radio fraternity, the FCC undertook, over a year ago, an informal study of the problems of interference from radio stations to telephone instruments. The results of this study were released on February 28, 1994, in a document entitled "Telephone Interference Survey." Although not a "scientific" survey in terms of the numbers of complaints and the types of complaints monitored, the results are very enlightening.

For example, the FCC receives about 25,000 complaints a year from individuals who are unable to use their telephones because nearby radio stations interfere with their instruments. Of these complaints, around half are the result of Citizens' Band operations, and the other half are mixed between broadcast and amateur radio operations. Also, it is estimated that this 25,000 figure is only the tip of the iceberg, because the FCC believes that the vast majority of complaints are not reported to that agency.

The FCC Study

In this study, a total of 35 FCC field offices around the country were asked to participate in the survey. Each field office was to select three complaints, at random, and to make the following measurements: station power output, antenna height, antenna gain, and distance from the antenna to the complaining party. In addition, the license type (e.g., amateur) of the station was to be determined. At each location all telephones were disconnected and taken to a chosen telephone jack. Then each telephone was tried while the station was broadcasting.

"As a result of this informal study, the FCC concluded that the telephone, and not the radio broadcasting station, was the cause of the problem."

Finally, several commercially available RF filters were tried on the telephones while having the station transmit again.

When these tests were complete, the FCC personnel connected a "bullet-proof" telephone to the same connection. A "bullet-proof" telephone is one which is designed to be immune from RF interference and manufactured as such by a reputable telephone manufacturer.

During these tests, a total of 108 transmitting stations were checked. These included a mix of the following:

Citizens' Band	47
Amateur	27
AM Broadcast	23
FM Broadcast	10
International Broadcast	1

The power output levels of these stations ranged from around two watts to half a million watts. Over one-third of the transmitting stations were using less than 10 watts, and around one-third were broadcast stations using from 3,000 to 500,000 watts. Thus, the cross-section of power levels was extreme.

A total of 241 telephones were tested at the complainants' residences. Of these, approximately 68% of the instruments had definite interference. Then commercial filters designed for the elimination of RF interference were tried. The first tested was the AT&T Z100B1 model. This filter only eliminated 38% of the interference, with 62% of the telephones tested still receiving interference. Various other manufacturers' filters were tested next. As a group, only 29% of the interference was eliminated, with the remaining 71% still having problems.

Virtually all manufacturers had telephones which fell into both categories. That is, they had models which received interference and those which did not. But a quick look at the list of telephones shows very few models appearing on both lists! For the most part, the telephones which received interference were different models from those which did not.

A total of 16 filters, representing seven model types manufactured by five different companies, did relieve interference in the 16 cases where tried. The FCC states that this is too small a sample to say that they will work in all cases, but they also say that the use of these filters deserves further study. These filters were manufactured by K-Com, Radio Shack, TCE, TEC, and TII.

Both of the "bullet-proof" telephones used in the study were manufactured and modified in the state of Texas. The first

type used was modified by Pro Distributors of Lubbock, and was built from a Western Electric Desk Model Touch-Tone telephone. TCE Labs of New Braunfels was the other model tested. The "bullet-proof" telephones were successful in 98% of the cases in eliminating radio frequency interference to the telephone system.

The Fault is in the Phone

As a result of this informal study, the FCC concluded that the telephone, and not the radio broadcasting station, was the cause of the problem. They stated that "manufacturers can design telephones to be interference free."

> ***"The FCC has been aware of these problems for many years, and, if pressed, will take the side of the radio operator."***

As a parallel note regarding the interference problem, the *BiCSi MemberLetter* (May/June, 1994; a newsletter published by the Building Industry Consulting Service International, the primary organization of communications consultants) states:

"The handwriting is on the wall. If our industry doesn't get its act together on this issue, the regulators will. The efforts being made today may not be enough to forestall regulation. As professionals, BICSI members should be aware of this problem and work with our customers to help them resolve their problem."

In addition, the Telecommunications Industry Association (TIA), in cooperation with the FCC, is undertaking a three-part program to help with the interference problem. The first part of this program is a public education effort which has produced a brochure called "What to do if you have interference problems on your telephone from radio, TV stations or other sources." This pamphlet states that if an amateur or Citizens' Band transmitter is causing the problem, the operator will usually be pleased to work with the telephone owner to solve the problem. However, it later states that in the case of radio and TV stations, the operator may not be required to help. The pamphlet goes on to state that the problem is then the responsibility of the telephone owner to solve.

The Station Operator's Obligation, or Not?

Unfortunately, this statement is not directly made concerning the amateur or citizens' band operator as well. But the situation is the same, for the amateur and CB operator are *not* required to take steps to eliminate the problem for the telephone owner. It is safe to say that most operators will make an effort to work with the telephone owner, but assumption of any liability should not be undertaken by any operator.

The second part of this program is to establish the preparation of an RFI immunity specification for telephone terminal equipment. This is definitely necessary in order to provide a benchmark from which the telephone industry can gauge its compliance with the problem.

Finally, the third stage includes a liaison effort among standards organizations to share what is known about RFI and to coordinate an effort to mitigate the problems.

There is a definite problem, especially in the urban and suburban area, with amateur transmitters causing interference to a variety of devices. TVI and HiFi I are also problematical in many locations. Fortunately (in most cases, and unfortunately in a few others), cable TV has contributed to a reduction in TVI from transmitters operating from 160 through 10 meters. Unfortunately, some of the cable channels fall directly within amateur VHF bands, and there is definitely a problem therein. HiFi I is also a problem, especially when the owner of the equipment has spent lots of money for an item that has little, or no, protection from RFI.

> ***"Be concerned, but be firm! The problem is in the telephone, and not the transmitter!"***

The FCC has been aware of these problems for many years, and, if pressed, will take the side of the radio operator. But until the release of the "Telephone Interference Survey" by the FCC, there has been only limited public awareness of the problems. This is a good start! Now when an irate telephone user approaches an amateur radio operator, he/she has a firm basis on which to base the reply. Be concerned, but be firm! The problem is in the telephone, and not the transmitter! Remember, over one-third of the problems happened with transmitters running less than 10 watts out!

If any reader wants a copy of the survey, I will be happy to provide it. Just send $2.00 to cover copying charges, and a 9" x 12" SASE with sufficient postage for four ounces to the *Callbook* address for W5UOJ.

73 Review

Number 11 on your Feedback card

by Gordon West WB6NOA

Icom America, Inc.
2380 116th Ave. NE
Bellevue, WA 98004
IC-Z1A
Price class: $715.00

Icom Z1A Dual-Band HT

It's definitely different!

Icom America calls their new dual-band IC-Z1A hand-held transceiver "the next generation." Amateur radio operators taking part in this review labeled the Z1A as "definitely different" with its detachable front panel that turns into a tethered, back-lit remote operating system. And everyone agreed that wearing the remote mike/control panel on your jacket collar turned many heads at local hamfests and ham club meetings.

The Icom America IC-Z1A is a $500+ dual-band handheld that is shipped with the remote microphone/control system, including the black curly cord. In other words, its most unique feature is not something that you'll need to spend some extra bucks on; it's all ready to go, transforming itself into a regular dual-band handheld with a front face that clicks out and attaches to the top of the unit via supplied rubber mike cord. The Z1A is also shipped with a battery pack that has absolutely no cells on the insidel This is actually a feature: The alkaline battery pack that comes with this set accepts four common AA alkaline cells that are available everywhere. You can therefore get on the air with your new unit as soon as you pop in the four cells. With other transceivers, it's a few hours' wait until the rechargeables come up to speed before you can begin operating your new set.

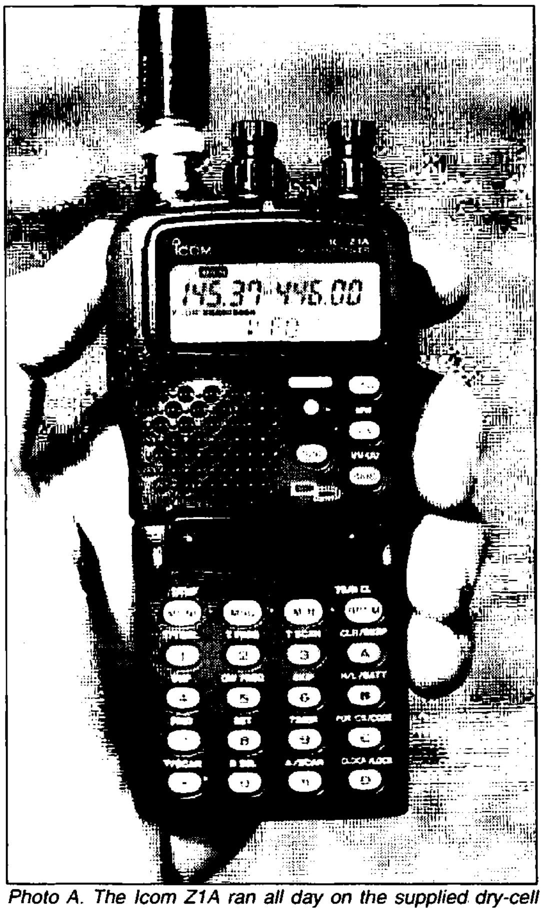


Photo A. The Icom Z1A ran all day on the supplied dry-cell battery pack holder.

Step-up HTs and the Z1A Difference

The Icom Z1A would be considered an advanced-operating radio for seasoned hams who have outgrown their present HT radio system. It might be considered similar to the following step-up HTs:

Alinco DJ-G5T
Kenwood TH-79A
Standard C528A
Yaesu FT-51R

What Icom did in the design of the Z1A was to take the remote mike capabilities a few steps further than the popular Yaesu MH-29A2B display microphone. The Icom remote mike is actually the integral display and control head that fits right on the HT itself, and quickly remotes out on the coiled black mike cord. The switchover takes less than five seconds, with seven gold-plated pins picking up the connection points. Just remember where you stash the OPC-500 remote display holder, because this Is the key feature that makes this handheld so unique in this price category. And keep in mind that the remote display system is included in the original price of the unit, unlike the optional remote mikes from the other manufacturers, including the display microphone from Yaesu that is sold separately.

During our review, we learned the programming techniques with the control head fixed right on the unit. This way we could hold the equipment with one hand, and be able to get at both the display control head as well as the keypad that stays on the body of the unit.

"During the design process of this equipment, there was consideration given to putting the entire keypad on the back side of the remote control head," comments Icom America. "But our research team made up of avid ham operators concluded that the remote control head with its curly cord did not need the keypad on the back side, because this would lead to additional unnecessary weight and the possibility of accidentally pushing a wrong button while talking into the microphone control head." And we agree. The detachable control head features a large LCD display that is extremely visible at all angles, alphanumeric readouts, up-and-down channel-changing buttons, and a couple of other buttons to quickly recall and memorize displayed frequencies in either VFO or MEMO mode. The built-in speaker on the detachable control head is adjusted via a volume push-button, and push-to-talk plus a nightlight are conveniently located where you would expect them to be: on the edge of the detachable remote head. And when you snap

the detachable head back onto the body of the unit, the buttons are exactly where you would want them to be if you weren't running the unit off of the coiled cord.

Turning It On the First Time

Before turning on the unit for the first time, we double-checked that we put in the alkaline batteries with the right polarity, slipped on the skinny, flexible dual-band antenna, and added the belt clip that doubles as the heat sink during prolonged TX contacts. We also attached the hand strap that I always like to curl around my little finger when operating the set in case something happens and it begins a downward plunge to the deck.

We tried the detachable control panel, and it slipped on and off while pushing the release buttons upward. The book says to be sure and do this with the power turned off, but during our test we tried it with the power on and there were no adverse results. We could even do it in the dark, aligning the connectors on the bottom of the dummy panel end of the OPC-500 and then clicking the top of the panel into place.

This panel wobbled slightly when snapped into place. This would be expected since it's a plastic-to-plastic fit with a spring-release mechanism on the outside tabs. We would have liked to see some sort of a little rubber O-ring for a more positive and tight fit. The slight wobble on the front panel was quite evident on transmit when we were exchanging reports with other stations. Since the push-to-talk is on the detachable part of the control head that slightly wobbles on the unit, we heard a slight grating sound on TX.

Bob Gregg AB6CH came up with the relatively simple cure of placing a thin foam pad between the two connected parts that gave us just enough pressure to keep the wobble down to no-wiggle, and the TX problem cured itself with everything on nice and tight.

Power-on is a small power button next to the speaker on the remote panel. The button has a relatively long play, which we judged to be a distinct advantage. Unless you really get your finger on it and push it all the way down, the unit does not accidentally get turned on or off. This is a big improvement over other transceivers we have tested that accidentally get switched on or off when you stick them in your pocket. You must depress this power button all the way in before the unit beeps and turns on.

The unit powers up on 146 and 440 MHz like all "brain-dead" mobile and hand-held dual-band transceivers do. It's hard to believe that, with today's radio cloning and CPU-loading technology, all manufacturer dual-band hand-held and mobile units have nothing in the memory, not even the "top 20" repeater pairs compiled by the American Radio Relay League as the most common channels throughout the country. While it's good for all new hams to learn how to program their handhelds from scratch, a few pre-memorized frequencies that would come up on initial turn-on seems absolutely logical to me so you can begin hearing some activity as you're reading over the manual and beginning to learn how to start the programming sequence.

"A quick push of the VOL button at the top of the remote unit allows you to adjust the volume of each band from the top knob."

Can you imagine buying a new stereo color television and, when you first turn it on, finding that you have to program the video frequencies and the audio frequencies into each and every channel for VHF, UHF, and cable? I know this sounds ridiculous, but why not have a handheld that powers up with the nation's most common repeater frequencies in memory, and even a few out-of-band national weather frequencies, too?

The unit powers up in the VFO mode, since there is nothing in memory. To change a frequency or to activate a function, you must first decide whether you want to play on VHF or UHF as the main band. Push the little band switch and watch it toggle between VHF or UHF with the word "main" appearing above the band that you have selected.

You can then change frequencies by turning what you might expect to be the volume control on the top of either the VHF or the UHF knobs, or pushing the up or down buttons, or punching in frequencies using the keypad on the bottom body of the HT. So where is the volume control? It's where you would expect it to be, on the top of each one of the knobs. A quick push of the VOL button at the top of the remote unit allows you to adjust the volume of each band from the top knob. The display registers between zero and 16 as you adjust the volume. When, after a few seconds, the radio sees no further volume change, the top knobs revert back to their channel changing function. We have seen this in other brands of transceivers; and after you get used to the procedure, it presents no problem. But when you first start using the unit, you might reach for the top knob to turn up or down the volume, and realize you have changed VFO frequencies or memory channels. Maybe in the SET mode there is a way of permanently setting the volume to the top of the two little knobs after you have preselected the VFO or memory modes. But then you wouldn't be able to change channels. I'll do some more thinking on this subject before I decide whether I can get used to this "feature" that many hams say they have mastered in no time at all! As I indicated at the beginning of the article, this is an advanced-function transceiver.

Receiver: Sensitive, Selective, and Pretty immune

After a few days of running the unit in the VFO mode, and the relatively simple memory process, we wanted some first impressions on the receiver section. Was it sensitive? Yes. Was it selective? Yes. Was it immune from intermod and desense from nearby strong stations off frequency? As good as the rest. When compared to other hand-held transceivers in this price class, the Z1A possesses almost identical sensitivity, selectivity, audio output, intermod rejection, and great receiver performance. While we did perform receiver and transmitter tests on an IFR service monitor, we felt the best test was to take the unit into a downtown area where inexpensive handhelds will begin to desense and break squelch on out-of-band signals. The Icom Z1A has a terrific receiver, and in the downtown "intermod alley," the unit performed exceptionally well on an outside dual-band an-

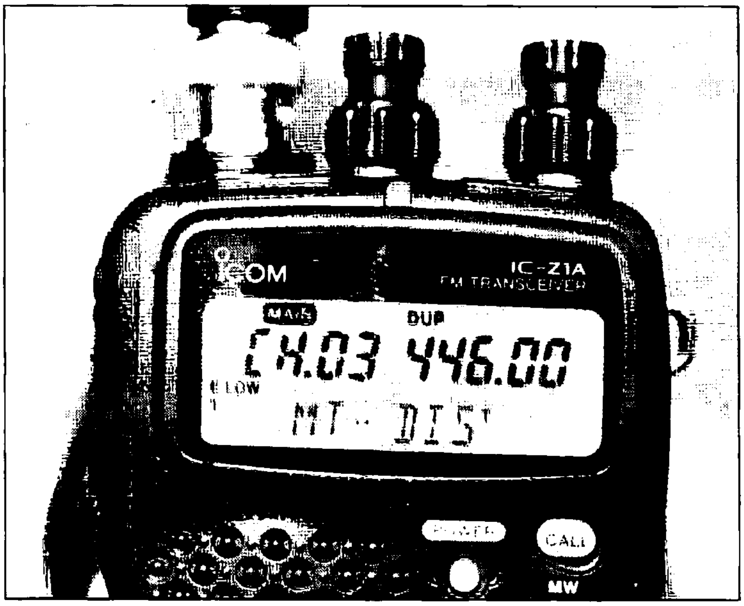


Photo B. Alphanumerics let us easily identify the repeater we dialed up.

tenna, with little sign of receiver wipeout from the saturation of incoming radio signals on a Friday afternoon. We also found that the extremely small speaker that is part of the detachable head did an amazing job of giving us great audio when the unit is worn joined together on the belt. And when you detach the control head and run the unit from your jacket collar, you have audio to spare!

On transmit, the unit ran relatively cool on our alkaline battery pack. When putting on a higher voltage rechargeable battery pack, or running the unit at 13.5 volts DC from the optional power cord, we saw up to 6 watts of power output on high power, a half a watt on low power, and 15 milliwatts on extremely low power which did an amazing job with working nearby repeaters. The unit automatically powers down to this extremely low power 15 milliwatts when the set detects low rechargeables or low alkaline batteries. This function can be turned on or off in the SET mode.

When operating through repeaters, we dialed up subaudible tone, and found the usual 33 CTCSS available and built in. Just about gone are the days in which you need to buy and install a separate tone encoder. However, we were disappointed not to see a built-in tone decode module as part of this package. Tone decode requires you to order the $50 UT-93 tone squelch unit that also gives you some pocket beep and page alert functions that only about one percent of hams in the United States ever use. However, most hams who operate CTCSS would certainly enjoy full decode capabilities in order to run with other units using the same tone on a simplex basis for quieter operation. The UT-93 slips under the battery compartment tray after you have carefully removed six screws and separated the front and rear panels as described in the instruction manual. If you're not into dissection, let a pal who does this every day give it a try. It just plugs in, and you wonder why the factory didn't already plug it in and charge you a few bucks more for the entire package, anyway.

We liked the auto-repeater function, where the unit in VFO automatically selects 600 kHz down or up, or 5 MHz down or up, as you go through the band. You can turn this on or off in the SET mode when you first program your handheld. And if you're looking for repeater activity, just hit the scan button, and away it goes until it locks onto an active frequency.

Memories

The transceiver has 46 memory channels, plus 3 pairs of scan-edge channels on each band for storage of often-used frequencies. Each memory channel can hold operating receive frequency, duplex up or down or simplex, subaudible tone encode, scan-skip or scan-hold, and best of all, memory channel names. It takes a few minutes of book reading (and we did like the all-English instruction manual) to learn how to select the letters or numbers for the memory name ID. Once you get rolling with the operation, it takes about 30 seconds to name each channel. If there is nothing for a name on a memorized channel, it comes up as "NON AME."

"These functions are cherished by savvy repeater control ops who regularly control their repeaters on UHF using a multifunction handheld."

And like all dual-band handholds, you have a call channel, five different types of scanning, memory scanning and individual memory skip, scan resume times, priority watch, and quick swaps of memory channels to VFO. These functions are cherished by savvy repeater control ops who regularly control their repeaters on UHF using a multi-function handheld. If you're not into this type of operation, it's nice to know the unit has the capabilities, and the Z1A does.

And it has a clock. After one week, it lost only 20 seconds. We did discover that the clock is powered by an internal rechargeable lithium battery when the main battery pack is detached or exhausted. If you don't have a fresh battery in your unit, the clock goes whacko after about a week, and you'll need to reset it after the built-in internal rechargeable lithium battery comes up to speed. We were worried that the clock might affect what was stored in memory, but it appears that this is not a problem. The memory stays put, even with the regular battery pack out of the unit.

Part of the clock circuit is a timer unit that can turn your set on and, better yet, turn it off automatically if you forget and leave it on. You can preset the automatic off function at 60 minutes, 40 minutes, or 20 minutes.

If you make a lot of autopatch calls, there is a six-memory DTMF storage for up to 30 digits in each slot.

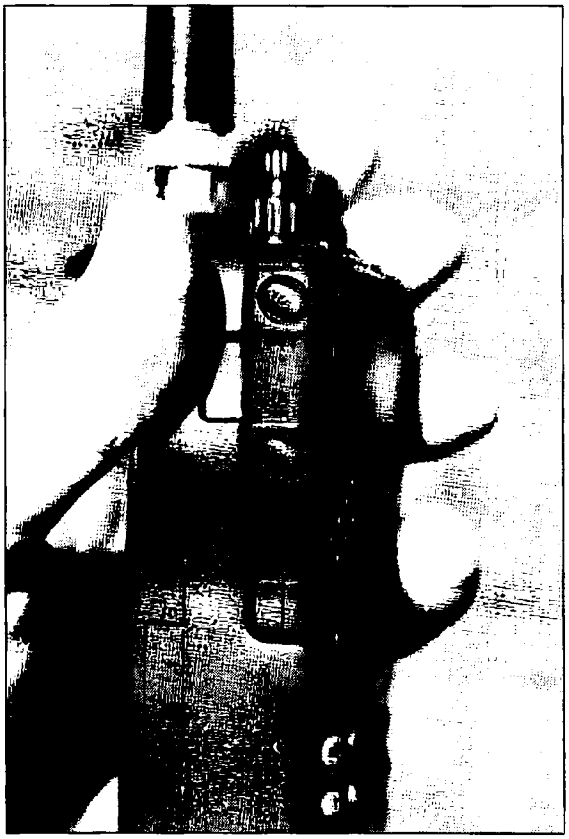


Photo C. You can see where the head detaches from the Z1A body.

Doing DTMF with Memory

To transmit a DTMF code, first select the memorized channel, dial up the DTMF memory number-sequence you want to send out, push PTT once to exit the DTMF memory mode, and then push PTT at the same time as the MONI button to transmit the selected DTMF code. And when you're first setting up this mode, make sure your repeater will accept the speed of the outgoing DTMF number string; if for some reason the repeater doesn't react fast enough, you can choose any one of four DTMF speeds to coincide with your system. A SET mode speed selection allows for a 100 millisecond-, 200 millisecond-, 300 millisecond- , and very slow 500 millisecond-sending of the characters. It goes from five characters per second all the way down to one character per second.

Another feature we discovered with the Icom Z1A was cross-band full-duplex and cross-band repeat capabilities. This allows you to listen on one band and transmit on another—either manually or automatically. And while this is relatively common in most handhelds, I must mention that this mode should not be engaged when in high power. For unattended cross-band repeater mode, a long-winded operator could actually cause the handheld to burn up if it is running on an external 13.5-volt power source. Your handheld is not intended to be a repeater; so use the cross-band duplex and cross-band repeat only in low power.

And speaking of low power, it's nice to know how much battery life you have left after you have been operating for a few minutes or hours on the air. You enable a battery voltage indication by first pushing

FUNCTION, and then BATT to indicate voltage from 4.5 volts to 15.5 volts with 1/2-volt increments. This is a great way to spot an alkaline pack beginning to die out, and also a great way to double-check that a rechargeable pack doesn't have a bad cell. With alkaline packs, you'll see the battery voltage slowly begin to decay as the battery pack delivers power. However, with rechargeable batteries, the battery voltage indicator does not tell you how much lite you have left. This is because rechargeables go until the very end, holding their own, and then drop within one minute from a normal state to "DOA." So plan to use the battery voltage indicator when running from an external voltage source, or running your set on alkalines in that four-cell alkaline holder that comes as part of the original package.

Photo D. The head detaches by moving the release buttons up.

SET Mode Features

We found some interesting features in the SET mode that really went along well with the detachable control head setup. One nice selection was the LCD contrast as well as lighting selection. When you run the remote head on your collar, it's helpful to have just the right amount of back lighting, as well as the right type of contrast on the LCD's display. We were extremely impressed with the LCD display because it could be seen at all angles. Some LCDs on other handhelds tend to negate the capability of seeing it when looking down on the display. On the Z1A, you could look at it from any angle and see it clearly.

The SET mode also allowed us to lock out the keypad that stays as part of the body when worn on your belt. We then discovered that there indeed was a way to set the volume switch that holds on the top knob. In fact, in the SET mode the volume switch can hold, push for volume, and then automatically cycle back in a 5-second audio mode. There were several other things that you could change when it came to CPU behavior in the SET mode, but what we were most interested in was how usable was the remote head when worn on a jacket or on a shirt lapel. *Very* usable, thanks to the layout of the buttons.

We liked the fact that you could go between VFO and memory mode without having to take the unit off your belt. It was also nice to be able to see the LCD memory channel display just by taking a glance at it over your shoulder. Plenty of audio, and great-sounding transmit on the detachable head.

"How about putting the antenna on the remote detachable head?" comments Roy Stephens AC6CQ, one of our evaluators of the Icom Z1A. Interesting idea, similar to that of Motorola equipment that public safety officers wear with the antenna at a much better spot than at belt level. Icom indicates it might consider this for new equipment coming up over the next few years, but for this set the antenna circuit is on the body of the unit and not the head. But they did indicate that simple antenna adapters are available that plug into the BNC jack and clip to a helmet or baseball cap, and with one additional tiny wire (coaxial), you have the same effect. They also point out that jacks are available on the top of the unit for conventional speaker/microphone assemblies when you run the unit with the detachable control head still on the body.

We judged the contents of the instruction manual to be of exceptional quality. Written in polished English, with all aspects of the Z1A well-documented, it includes a functionality diagram of the button-pushing process, as well as a small abridged cheat-sheet that you carry with you in case you need to do something that you forgot a few days earlier.

We were surprised to hear this unit does not clone. Too bad—it's time-consuming to duplicate all of the memory channel information and alphanumerics from one unit to another without the cloning feature. Icom says cloning is in the future, but not with the Z1A.

Conclusions

Is the Z1A for beginners? Certainly so—and as you grow into the radio, you can begin to use many of the advanced features that are detailed well in the manual. But if you have already mastered your present dual-band handheld, and you're looking for more in the control head/mike, this has got it! It's also quite a potent conversation piece when people spot the body of the unit on your belt, and the control head/mike up on your shoulder with terrific-sounding receive audio.

The unit also tunes out-of-band frequencies, including aeronautical, and this we come to expect with any good dual-band handheld in this price range. We ran it for several weeks on a fresh set of alkaline cells, and the unique battery-saver circuit that cuts current down to as low as 32 milliamps gave us plenty of time on the pack before we needed to substitute fresh cells.

We think Icom has another versatile advanced-feature handheld that is great for both beginners as well as those operators wanting the ultimate dual-band HT. The focus groups who helped shape this new unit electronically did an excellent job, and Icom America always welcomes suggestions on what they can do next to top some exciting products that they are presently marketing. Don't forget the foam rubber behind the control head to quiet the rattle, and you'll be all set with one unique dual-band, detachable-head handheld.

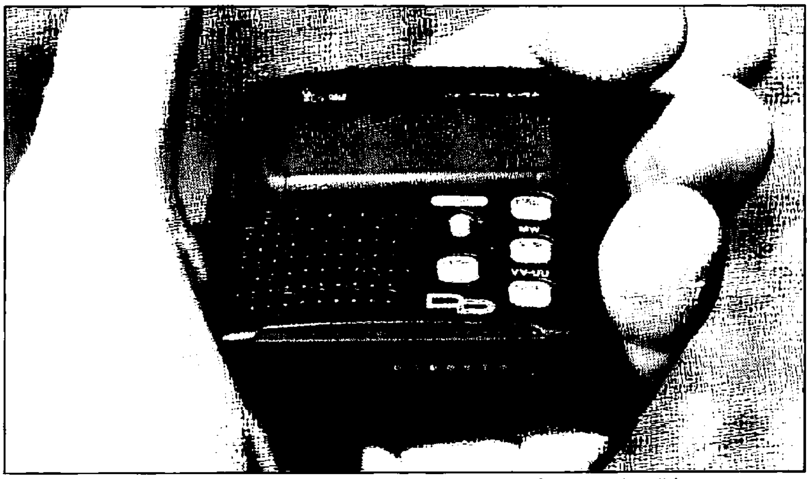


Photo E. Gold contacts on the detachable head make for a good, solid contact.

73 Review

Number 12 on your Feedback card

by Gary Sargent KE8WO

Hewlett Packard Company
Direct Marketing Organization
Box 58059 Mail Stop 511-L
Santa Clara, CA 95051-8059
Phone: (800)-752-0900
Price Class: HP 200-LX $549 (w/1MB RAM))
$699 (w/2MB RAM)

Hewlett Packard 200LX Palmtop Computer

What, another computer? Try this one on for size.

There are far more computer manufacturers than Heinz has varieties! Since they are all pretty much the same, why in the world is one being reviewed in these pages? The Hewlett Packard 200LX is unique and has significant features that will interest the amateur radio community.

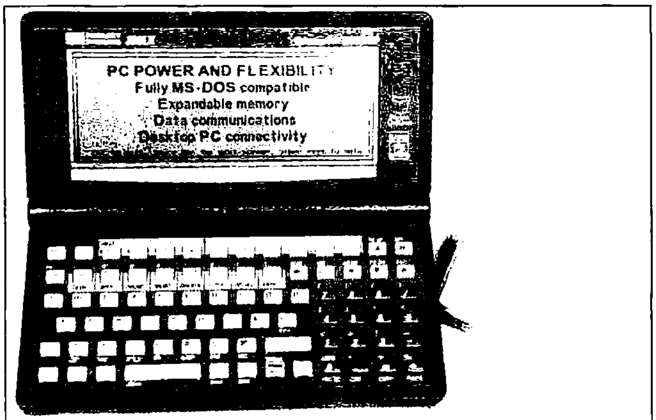


Photo A. The usefulness of the Hewlett Packard 200LX is greatly enhanced by it's being pocket-sized.

Smaller is Better!

The key to the value of the HP 200LX is its size and its built-in programs. Like HTs, camcorders, cellular phones, and other electronic gizmos, think of how useful your HT would be if it were still the size of a Heathkit lunchbox 2 meter rig. Not very. A pocket-sized device provides utility and convenience that magnifies its other features.

So it is with the HP 200LX. The 200LX is a PC XT compatible computer that fits in your shirt pocket! Imagine a full-featured PC that is 6.3" x 3.4" x 1" and weighs a mere 11 ounces. Add this extremely small size to its extensive collection of built-in programs and you have a very useful device.

Big on Features

The 200LX is an IBM PC/XT-compatible computer operating at 8 MHz, a DOS-based machine that is not intended to run Windows and associated RAM- and CPU-intensive programs. By modern standards, an XT computer will not knock your socks off, but its computing performance is entirely sufficient for the unit's built-in programs and the tasks for which it's designed.

The 200LX features a full, albeit small, keyboard with the familiar QWERTY layout. The 82 keys include ten function keys, eight dedicated application keys, inverted "T" cursor control keys and a numeric keypad. The keys have a good feel and are very much like a calculator, which makes sense since HP's calculator division designed and manufactures the 200LX. The keyboard is quite small and does not lend itself to typing-intensive activities. If your hands and fingers are of average dexterity, you will have no problem with the keyboard for light to moderate use. You should try the unit before buying, to insure you can live with the keyboard. I managed to write this review on the 200LX using its built-in Memo Editor program.

The display is a CGA-compatible LCD that measures about 2 by 5 inches. Graphics resolution is 640 by 200 pixels. This small a display could make for very small characters, but the 200LX features three character sizes which compare well with those in today's typical notebook computers. The display is not backlit, so good ambient lighting is required to make it readable.

The 200LX comes in two models: with one or with two megabytes of RAM. The model reviewed here is one megabyte. The system RAM is battery-backed-up static ram. Memory contents are preserved when power is turned off. In fact, when the unit is turned on, the program in use when the power was turned off continues from exactly where it left off. No reboot required.

A serial port is provided on the side of the 200LX, requiring a ten-pin connector and cable to access. It then becomes a PC-compatible serial port operating at all standard baud rates up to 115,000. It can be used to control modems, TNCs, HF rigs, etc.

An industry standard PCMCIA type II interface slot is provided for expanding the unit with more memory, a modem, or other device. Memory cards of 40 or more megabytes may be used to provide additional user program and data storage. Memory plugged into this slot appears as the system's "A" disk drive.

The 200LX operates from just two AA batteries that provide a typical four weeks of use between battery changes. An additional coin cell provides memory backup protection while changing the main batteries. NiCd cells may be used, and the 200LX even includes NiCd charge control circuitry.

Loads of Built-in Software

The HP 200LX includes a number of top-quality programs. All programs use a Windows-like drop-down menu motif that provides easy control and use.

The following are the major programs:

• *Appointment Book:*
Week-at-a-glance, month-at-a-glance, and six-month calendar;
Daily schedule with appointment alarms;
Daily, weekly, monthly, and yearly repeating events and appointments;
To-do list with automatic carry-over of past due items.

• *Pocket Quicken:*
Enter and edit transactions in checking, savings, credit card, and cash accounts;
Review account balances and register;
Reconcile accounts;
Create and print financial reports;
Share data with desktop versions of Quicken.

• *Lotus 123 v.2.4:*
Worksheets up to 256 columns by 8,192 rows;
Graphics;
Database commands;
Macro creation and execution;
@ functions from @ABS to @YEAR.

• *Phone Book:*
Alphabetical list of names and numbers;
Contact information cards;
Search and sort on any field.

• *Memo Editor:*
Text entry and editing including block cut/copy/paste, search and replace, bold, and underline;
ASCII file format for reading and editing;

Outliner with promote and demote features.

• *HP Financial Calculator:*
General and technical math functions;
Time-value-of-money functions;
HP Solve equation-writing capability plus equation plotting;
Currency and unit conversions;
Algebraic or RPN data entry;
Cash flow analysis (IRR, NPV) and statistics functions, both with plotting capability.

• *Database:*
Create and modify database templates;
Add, delete, and edit records;
Search and sort by field or text.

• *World Time and Stopwatch:*
Local and world time for over 450 cities;
World map customer city list;
Timer and stopwatch.

• *Data Communications:*
Transfer messages or files via modem or connection to the serial port;
VT-100, ANSI, and TTY terminal emulation;
Kermit, ASCII text, and X/Y/Z modem file transfer capability;
File capture capability saves data from terminal session.

All programs are included in the on-board three megabytes of ROM. Programs are launched by pressing one or two keys assigned to the program. Just press the Lotus 123 key and there it is. This makes it very simple to jump from program to program . . . you don't even have to end a program before going to another. For example, you can be in the middle of the data communications program and a packet QSO, and you want to use the database program to check your log. Simply press the two-button sequence to launch the database program. When finished, the terminal program continues exactly from where you left off.

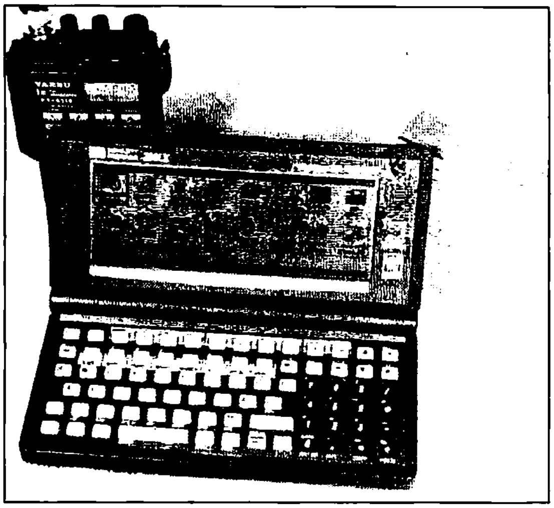


Photo B. The 200LX can control your HF rig via a DOS-based program available for all of the popular rigs that sport a computer connection.

Some Ham Uses

The Database program can be used to develop a logbook database quickly to track all your contacts. The database can be searched or sorted by date/time, call, name, state, or country, or any user-defined fields you decide to enter on your logbook. The 200LX can be located in a small spot in your operating position, not dominating the area like a desktop or even a notebook PC would. I have a database that contains frequency, location, description, and channel numbers for all the memory channels in my Yaesu FT-411, PRO-43, PRO-2006, and TS-440 radios . . . a total of 750 memories locations!

The 200LX can control your HF rig via a DOS-based program available for all of the popular rigs that sport a computer connection. Additional rig features, like custom scanning, additional memory channels, and automatic frequency logging are provided. You will appreciate the fact that the 200LX is relatively quiet . . . it generates little RFI.

The 200LX works nicely as a computer connected to a TNC as part of a packet station. The built-in communications program provides good capabilities for this function. For the ultimate shirt-pocket packet, combine a 200LX with your favorite micro-HT and a small TNC (like the cigarette-box-sized PacComm PicoPacket). A complete packet station that fits in three pockets!

The built-in appointment and to-do list manager are useful to track contact schedules, nets, and other activities. The appointment function includes an audible alarm that will sound even if you are in another program. Each appointment may include an audible alarm to alert you to a user-specified number of minutes ahead of time. For example, you can set an appointment to sound and remind you of the swap net. The 200LX will sound the alarm at the appointed day and time whether it is off or on or whatever program it happens to be running at that time.

The Worldtime application allows you to easily look up hundreds of cities around the world. Each city contains present local time, latitude, longitude, phone prefix, and location on the world map. An available program converts the map into a dynamic map of the world with the sunrise and sunset areas displayed.

So . . . Is This Thing Worth $500?

You have to answer that for yourself. The HP 200LX is a very well made and useful pocket computer. It's second to none on the market in fulfilling the intended business and personal schedule and activities management roles, and the 200LX offers these features in a size that will appeal to many hams.

73 Review

Number 13 on your Feedback card

by Michael Geier KB1UM

Standard Radio Corporation
P.O. Box 48480
Niles, IL 60714
(312) 763-0081
"WBander" C508A Dual-band HT
Price class: $345.00

Teeny Talkie!

Standard redefines "small."

Do you believe in love at first sight? I do, and I always have. If I ever were in doubt, my first look at the new Standard C508A made me believe again. OK, I admit it, I'm a pushover for tiny electronic gadgets. When Standard released the ultra-small, single-band C108A last year, my interest was definitely piqued. But, when I saw this even smaller, dual-band HT at Dayton, I was absolutely floored, a feat not easily accomplished with this slightly jaded reviewer. This radio isn't just somewhat smaller than other walkies; it's in a whole new size class. I knew I just had to have one right away, and out came the ol' credit card. Although hundreds of the rigs were sold at the hamfest, I was lucky enough to get one of the last ones there.

You Gotta Be Kidding

At about 2-1/4" x 3-1/3" x 1", this incredibly tiny dual-bander looks like a shrunken, well-made mockup of a walkie, right down to its scaled-down rubber duckie. Surely it can't be a real radio! As soon as I handled it, though, I knew it was, indeed, a real HT. The fit and finish are as fine as on any rig made, and the overall feel is solid, despite the total weight of about 5-1/2 ounces, including batteries!

OK, so it's a real rig. But what can it do? How about both 2 meters and 440? How about CTCSS encode *and* decode? How about 60 memories, two call channels, and multiple VFOs? Happy yet? There's lots more, including band and memory scanning, menu operation, and very extended receive capabilities, with an AM detector for the aircraft band!

The Basics

The radio looks like most other HTs, only smaller. It has the usual rubberized PTT and lamp buttons on the left side, along with a "function" button which is used with the other controls to set various parameters. The LCD is decent sized for such a small radio, and shows your operating frequency, memory channel number, offset direction, S-meter, tone status, and other things. It's well laid out and easy to read. The lamp button lights it up well with two green LEDs, which stay on as long as you keep operating the controls and then go out a few seconds later. If you want, you can lock them on.

On top are the antenna connector, mike and earphone jacks, and the dial knob. In keeping with the excellent weatherproofing of the case, there's a rubber cover over the jacks, and it stays attached when you flip it up, so you can't lose it. Also, the rubber from the PTT button extends up to the antenna jack. The antenna jack is not the usual BNC type, though. Instead, it's a screw-on SMA jack of the same kind used on some handheld cellular phones. It's much smaller than a BNC, and the rubber of the antenna mates directly to the case's rubber, keeping water out much better than could be achieved with a BNC. Don't be disheartened, though, because an SMA-to-BNC adapter can be had at radio dealers for a couple of bucks, allowing you to connect any kind of antenna you want. I got my adapter for $3.00 at one of those "bins and bins of connectors" dealers at Dayton, and several folks mentioned that you can get them at Radio Shack, although I don't know the catalog number.

Below the LCD are five buttons, and there are two more below them, with the speaker and mike at the bottom. On the right side of the radio is a large volume control. Where's the squelch control? There isn't one! The squelch is preset to be fairly sensitive, and it works well, opening on weak signals but staying closed on noise. If, though, you're in a high-noise environment and need a tighter squelch, you can set it from the menu to any one of five higher settings, cued to the S-meter reading. I haven't had to do it, and I don't miss the squelch control, which often gets accidentally misadjusted on my other HT.

The batteries go in the back, under a sliding cover. To prevent the cover's coming off, there's a nifty lock on the bottom of the radio which clicks solidly closed.

Of course, the basic point of this thing is its size. With its approximate dimensions of a pocket pager, you can't help but take the radio with you wherever you go. With this remarkable feat of miniaturization, something had to give, and something did: the transmit output power. The rig puts out 280 mW on both bands. Admittedly, it's not much compared to the 2.5 to 3 watts you get from bigger HTs. Can you really do anything with 280 mW? Surprisingly, you really can! In addition to the obvious hamfest and short-range simplex applications, I was able to work four or five repeaters in Dayton, and several at a friend's house in Indiana, on the way home. And I don't just mean I could key them up; I could really communicate through them, usually with full-quieting signal reports. Not bad for such low power.

The great part about the low-power operation is its easy battery requirement. Although an optional NiCd pack and charger are available, the rig isn't supplied with them, and you don't need them. Probably the best aspect of this rig, aside from its dimensions, is that it operates from two alkaline AA cells. Never again do you have to wonder whether you charged your pack, or worry about buying expensive, new packs every couple of years. Just stick two AAs in and go! If you really want rechargeables, you can use the Ray-O-Vac "Renewal" alkalines. I've had little luck using them in most high-current applications, but they work great in this HT, thanks to its low 280-mA transmit current draw.

What It Does

This little gem does a great deal! Receive frequency coverage is quite wide, from 100–200 MHz, 300–400 MHz, 400–519 MHz and 700 to almost 1,000 MHz (cellular locked out, of course). Transmit is limited to the ham bands, but can be extended for MARS and CAP. In actual use, the radio doesn't quite reach all the frequencies it can display. Although it will let you tune those wide frequency bands, the PLL tends to unlock at the extreme edges of the bands, which is not at all unreasonable, given how huge the frequency spans are. As with many HTs, the display blinks when the PLL is out of range. The published specs are from 100–180, 340–400, and 400–480 (they don't mention the 800-MHz coverage), and my radio stays in lock within those segments and then some. Actually, I wish it wouldn't tune to the unlocked frequencies, because that slows band scanning way down as the rig enters into unreachable terri-

tory and halts as it tries to lock up. Oh well, I guess that's what the programmable scan limits are for.

The HT offers a VFO for each frequency span (4 total) and two "call" memories, one each for 2 meters and 440, along with 60 memories, each of which can be tuned like a VFO. The usual internal lithium battery backs them up. Unlike most dual-banders, this one lets you freely mix frequency bands from memory to memory. So, you're not limited to dividing the memories into, say, 30 per band. That's great if you live where most of the nearby machines are on one band. It's also great for scanning, because you can scan frequencies from different bands in any order you like. The scan options are extensive, by the way. In addition to the usual band and memory scans, this radio lets you scan by blocks of 10 memories, by marked memories, or by programmed frequency limits. Amazingly, it lets you enter 10 sets of limits. That way, you can scan the public service bands when you feel like it, and then scan the ham bands later on without having to re-enter anything. It's pretty nice.

As I mentioned, CTCSS encode and decode are included. The usual 39 tones are supported, and the radio will scan through them for you, looking for a tone being transmitted by a repeater. As with most rigs, you can set up to transmit tone, or both transmit and receive with it. There's also a 1,750-Hz tone burst function, in case you go to Europe and want to key up. (Don't forget to get that reciprocal license first!)

Each memory can hold separate transmit and receive frequencies, and they can even be on different bands! Yup, you can work crossband with this thing. It doesn't appear to do full duplex, but I've never found a use for that anyway. In addition to the separate frequencies, you can also set different offsets into each memory, making the programming of odd-split repeaters easy.

Selectable automatic power-off and battery saver times can be set from the menu. Also, a handy programmable key feature lets you put one of the SET mode functions into an easily accessible keypress so you don't have to scroll through the menus to get at it.

What It Doesn't Do

While offering most of the modern amenities, this HT is a little different in some ways. The radio comes with the antenna, a belt clip, a hand strap, and the manual. That's it. Naturally, there's no wall charger, because there's no NiCd pack. At first, I was puzzled by the inclusion of the belt clip. After all, who would possibly want to put such a tiny radio on a belt? After trying to carry the rig in my shirt pocket, though, I realized the wisdom of adding the belt clip. This thing is so small and light that it will easily go flying out of your pocket if you bend over. I attached the clip and solved the problem.

Some features offered on many HTs are not present. The biggest omission is DTMF capability. I don't miss the DTMF paging stuff, since nobody uses it anyway. But, there's no way to send DTMF tones, so you can't use the radio for autopatching. I thought about that before buying the rig, but then I asked myself when I last actually used a patch, and I couldn't even remember. Although autopatch can be handy, I think it is used mostly by new hams until the thrill wears off. I suppose you could play the tones from a pocket dialer into the mike, but I haven't tried it.

There's no provision for direct DC input. No, you can't plug in car power and get five watts out of this thing! The rig is made to operate on no more than 3.5 volts, and higher voltages will damage it. With the transmitter's low current drain, it really is silly to try to operate on anything other than batteries. Also, there's no "low power" setting. With a maximum 280-mW output, who needs it?

Many dual-banders can listen to two frequencies at once. Not this one. According to the block diagram (the unit comes with no schematic), both the VHF and UHF receiver sections share the same IF and detector circuits, being separate only in the front ends through the first mixers. Oh well, who really needs dual reception anyway? I've used it now and then, but can certainly live without it. Unfortunately, there's also no priority watch, and that's a shame, because it would have helped make up for the lack of dual reception. It's strictly a software function, and could have been included at no extra cost.

There's no low-battery indication of any kind on the display. I've yet to actually run a set of batteries all the way down (!), so I don't know what happens when you do. Also, there's no automatic repeater offset, and stepping through the menus to select the offset direction is a pain. I set up my programmable key for this function, making it easy as pie.

On the Air

Using the radio is much easier than I expected it to be. The menu operation is fairly straightforward, and I was able to figure out how to put a few repeaters and their offsets and CTCSS tones into memory without even looking at the book. I'm an old hand, though; less experienced users will probably have to read the manual.

The receiver is quite good. Although the sensitivity spec is not quite as hot as on my bigger HT, I can't really tell much difference on weak signals, as long as I use the big HT's antenna on both radios. With the included mini-antenna, though, sensitivity in the VHF public service band drops off quite a bit, although it's almost as good as the bigger one in the ham bands. For its size, the diminutive duckie is darned decent. Adjacent-channel receiver selectivity is about average; I've seen 'em tighter and I've seen 'em looser. The literature claims exceptional intermod rejection, but I have no way to test that, as I live in the country, far from interference sources. As far as birdies are concerned, I haven't found any, although I admit I haven't scanned every frequency on this very wide-band thing. The scan speed is pretty fast, but the memory scan is a bit slower. Still, it's on a par with most HTs.

The transmit audio is among the best I've ever heard. I got several unsolicited comments on how great the HT sounded. Receive audio is another story. The rig only puts out 100 mW at 10% distortion, and it really shows, especially with the necessarily small speaker. At anything more than very moderate volume levels, the sound clips and distorts quite a bit. Wisely, though, the designers let you turn it up anyway. Even with all the clipping, it's quite intelligible, if not pleasant, and the extra volume really helps outside. In the car, you'll have to hold it up to your ear or use a speaker-mike.

What I Liked

This tiny HT does just about everything people actually use, and then some. It's small, it's cute, and it's fun. It's well made, it performs very nicely, and it runs on two AA cells. The wide receiver coverage is great.

What I Didn't Like

The LCD window is convex and high; it's gonna get scratched if you're not careful. Also, its shape makes it act like a lens, causing overhead room lighting to glare from it, obscuring the display. Although the display can be viewed at any angle in ambient light, you have to look at it from above when you use the backlight or it washes out.

As I mentioned, you can't send DTMF. Some keypadless rigs let you do it by programming the numbers into memory first; that would have been nice. I guess there just wasn't room for the DTMF chip.

Although the menu operation is not hard to remember, a wallet-sized cheat sheet would still be handy. But, it would have to be better prepared than the manual, which is written in "Jenglish" and contains phrases such as "at initial state, this function is set My key" and "the Frequency Lock is stored after done the All reset or VFO reset." The Big Three appear to have learned to use native English speakers to edit their manuals, and I hope Standard catches on soon. I also hope they start including a full schematic. We're hams, not just consumers, and we want to know what's inside.

Conclusion

This tiny radio continues Standard's long tradition of making tiny electronics. Back in the '60s, they made the Micronic Ruby series of ultra-small AM pocket radios (if anybody has one he or she will part with, please contact me; I've been looking for one since I was a kid!), and now they're doing the same thing with HTs.

I love this thing! In fact, I'm so fond of it that it makes my girlfriend jealous. With its low output power and lack of DTMF, it is clearly not intended to be your primary rig. But, if you can live with those limitations, you will have a ball with this radio, assuming you like your toys tiny, as I do. It's especially nice for hamfests and travel; you won't leave it home. The C508A is an awesome feat of engineering, and, being the least expensive dual-bander around, it's a bargain, too.

A Simple Precision Voltage Standard

A tool for the serious builder's workbench

by Marion D. Kitchens K4GOK

Standards are an important part of any serious electronic builder's workbench, necessary for checking and verifying purchased equipment, and absolutely critical for setting up and calibrating a builder's new creations. A known, precision voltage reference is perhaps one of the most important standards needed, since checking and calibrating the output of test equipment depends on known, accurate references. Almost everyone has a digital multimeter capable of at least three-place decimal readings, and some with four-place readings. But how do you know if those readings are accurate? Many make the mistake of believing that just because an instrument reads all those digits they are accurate to that degree. Accurately known voltage sources are important in setting up digital-to-analog, and analog-to-digital converters. Digital ammeters can be calibrated or checked with easy-to-find surplus precision resistors (to at least the 1% accuracy level), if you have a known voltage reference like the one described here. The stability of voltage sources in your operating equipment can be measured by comparison to a stable, known reference. The precision voltage reference described here is designed to assist the serious builder in resolving the above problems with an easy-to-build and -use voltage standard. A PCB layout is provided, including a built-in 110 VAC power supply for those builders who desire to make their own. FAR Circuits offers boards to make building easy (see Parts List). All parts are available from sources such as Radio Shack, except for the AD586 chip, which is available from Newark Electronics and Allied Electronics.

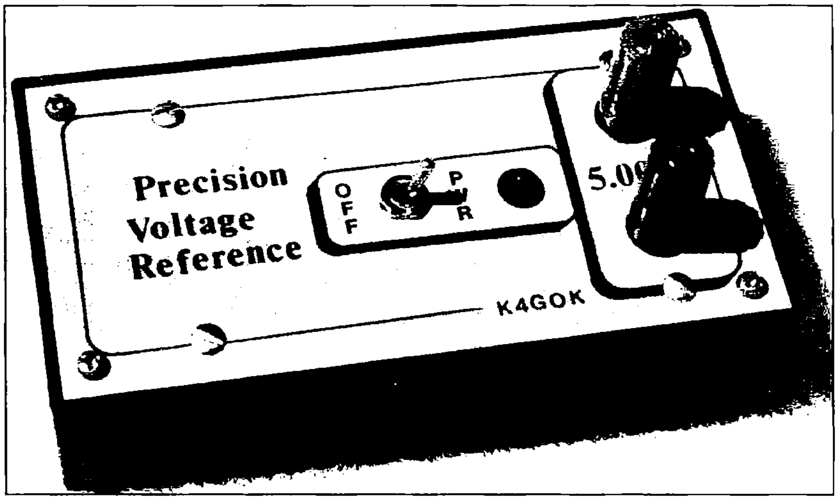


Photo A. The completed unit.

Photo B. Components and connector mounting.

There are no tricky adjustments or fussy components. The circuit is a hassle-free voltage standard. All components are mounted directly on the PCB, making for a integral unit that is easy to assemble and mount in an enclosure. This reference standard provides a basic precision of two parts out of 5,000, or about 0.04%.

The Circuit

The circuit is based on the Analog Devices AD586 integrated circuit. Except for a power source, this IC has everything needed built directly into the chip, with laser-trimmed resistors "fine-tuning" the

output to 5.000 ± 0.002 volts. Internal temperature-compensating resistors are also laser-trimmed at manufacture to maintain the precision output over a range of 0 to 70° C (M grade device), well within any normal use a builder might encounter. If you have access to a higher precision voltage source, there are provisions for further fine adjustment of the output voltage—if you need more precision! The project described here can be operated from 110 VAC or from a simple 10- to 25-volt source, such as an auto battery under the operating table, or for portable operating from two 9-volt transistor batteries in series. Current drain from the battery is about 15 mA, with most of that for the LED "on" indicator, thus offering long portable use on the 9-volt batteries. Functionally, the project consists of a power supply and the AD586 chip. This is a very simple circuit with excellent performance. Figure 1 shows the complete schematic of this precision voltage standard.

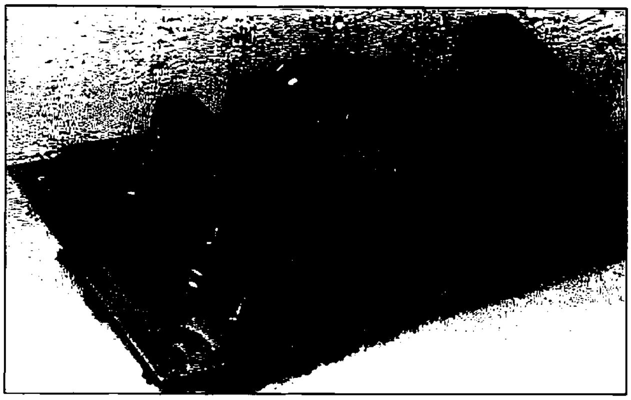


Photo C. Switch mounting and wiring.


Photo D. Switch, LED, and binding posts on foil side of board.

Construction

Construction of this simple project is very straightforward when using the PCB, shown in Figure 2. The PCB layout is shown from the foil side. Don't forget to reverse it if using the Tech 200 or similar technique. The circuit is simple enough that perf board and point-to-point wiring is a practical alternative to the PCB construction. Placement of the components is shown in Figure 3. The photos show the PCB construction, and the mounting of the board inside the enclosure. A Radio Shack enclosure (#270-233) will house the completed board. Note that the on-off switch and the output posts are mounted from the foil side of the PCB and connections are made via short pieces of solid wire. The LED is also mounted from the foil side of the board. The entire assembly is then mounted to the cover of the enclosure. The 110-VAC input and the external power connectors are mounted directly to the PCB, using Superglue and support blocks as shown. The photos show how the parts are mounted on the PCB to make a small, self-contained unit. There are no adjustments necessary to this precision voltage source—this has all been done for you by the manufacturer. This is a "plug in the parts and use" type of project. However, for those who desire the utmost in precision and have access to a more precise voltage reference, it is possible to make small adjustments to the output voltage. A 10k trimpot can be connected between the output and ground, with the wiper of the pot connected to pin 5 of the IC.

"The circuit is simple enough that perf board and point-to-point wiring is a practical alternative to the PCB construction."

According to the Analog Devices data sheet, this will allow adjustments of about 300 millivolts in the output. No provisions are incorporated on the PCB for this trimming, but there is ample space for the addition. Of course, if you are attempting to achieve a more precise 5-volt output than the basic chip provides, then you must have access to a known voltage source of the desired precision. I don't have access to the standards at the National Institute of Standards and Technology, so I settled for the 2-millivolt precision of the basic chip as built by Analog Devices.

Check-Out

Check-out of this project is quite easy. As always, check for any wiring errors, solder bridges, and the like. Make sure the rectifier is oriented properly; some rectifier units are not well-marked. With the chip out of its socket, apply 110 VAC and turn on the switch. The LED should light immediately. Next check that there is about 25 VDC at pin 2 of the IC socket. If the LED does not light or the voltage is wrong, find the problem and fix it before proceeding. Next turn off the power and wait for the LED to go out completely. Remove the power cord from the AC outlet. You want no voltage on the IC socket when you plug in the AD586 chip. Make sure the 30-µF and 1-µF caps are discharged. Install the AD586 chip, making sure it is oriented properly. Connect your voltmeter to the 5.000 VDC output connectors. Reconnect the AC line cord and turn on the switch.

The LED should light and the voltmeter should read 5.000 volts immediately. Check for proper battery operation by removing the AC line cord and connecting a 10- to 25-volt sup-

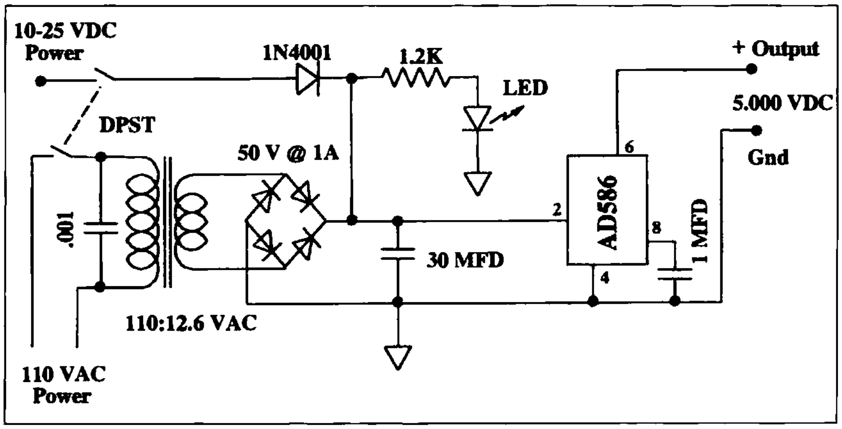


Figure 1. Schematic for the precision 5.000-volt reference.

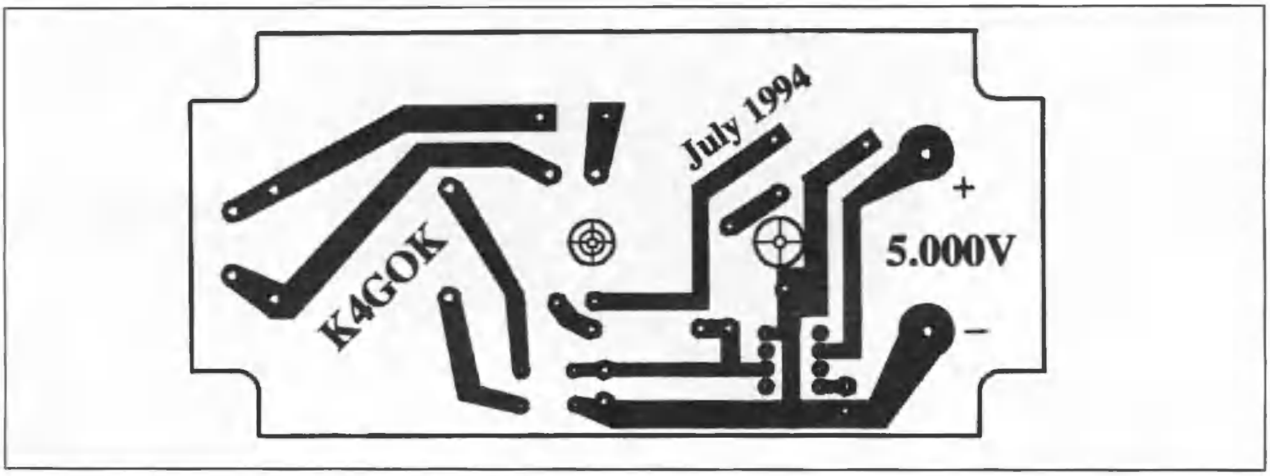


Figure 2. PCB foil pattern—view from copper foil side.

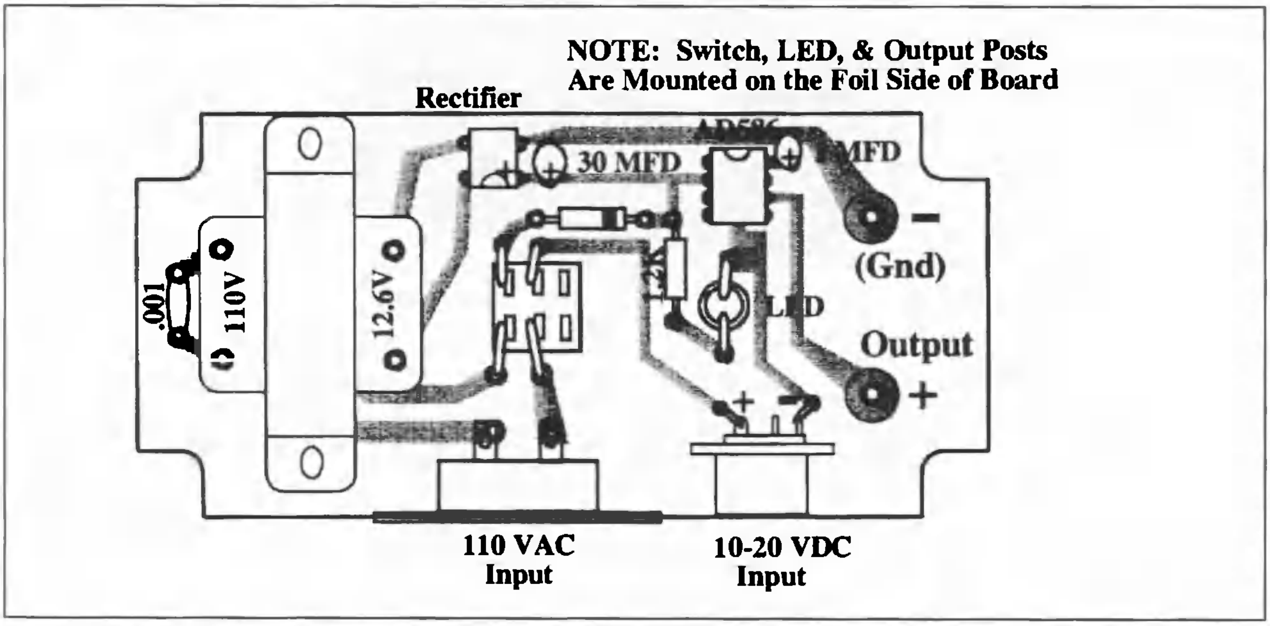


Figure 3. Parts placement—view from component side.

Parts List

Resistor	1.2k @ 1/4 W
Capacitors	30 µF @ 30 V
	1 µF @ 30 V
	0.001 µF @ 1 kV
Diode	1N4001
Rectifier	1A @ 200 V
LED	
Binding posts	
Toggle switch	
Transformer	12.6 V @ 300 mA
DC power connector	
110 VAC power connector	
Container	
AD586 chip	Newark Electronics or Allied Electronics
PCB	FAR Circuits, 18N640 Field Court, Dundee, IL 60118 ($6.75 + $1.50 S&H per order.)

ply to the external DC power jack. Turn on the switch. The LED should light and the output should be 5.000 volts as above. If the LED doesn't light, check for proper polarity from the external supply. Note that the battery and the internal AC power supply are diode isolated, and therefore can be left connected without any interactions between the supplies.

Performance Tests

Warm-up tests from a cold start showed no measurable charges in the output voltage over a 10-minute period. The warm-up voltage was stable within the + 0.0005 limits of the test equipment. The output voltage was checked after a series of other tests, and remained unchanged. Output stability was also measured over the range of 100 to 130 VAC line voltage. There was no measurable voltage change over this range. DC supply variations did produce measur-

able changes, as shown in the graph of Figure 4. Note that the unit requires at least 10 VDC for a proper output voltage. Supply voltages below 10 VDC produce a sharp drop in the output voltage. Also note that the output remains very stable up to the maximum supply voltage at which it was tested, 25 VDC. The maximum change in output voltage was 0.001 over the supply range of 10 to 25 volts. Note the high stability of the output voltage during all of these tests. Figure 5 shows the results of comparing three different DMMs. The test setup shown at the top of the figure illustrates the technique used to get increased digital resolution on the DMMs. Note that this test only compares one DMM with another, and does not indicate which is more accurate in absolute terms. The sidebar describes techniques for improving the resolution, but not the accuracy, of DMM measurements as used in these performance tests.

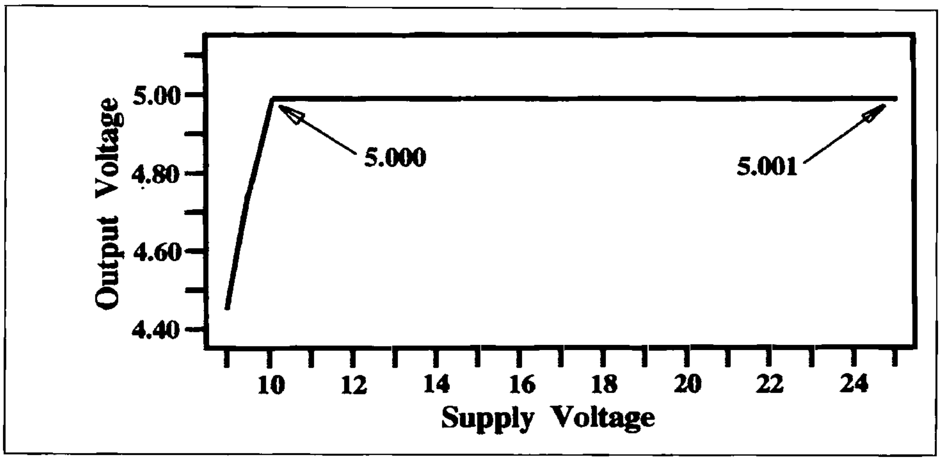
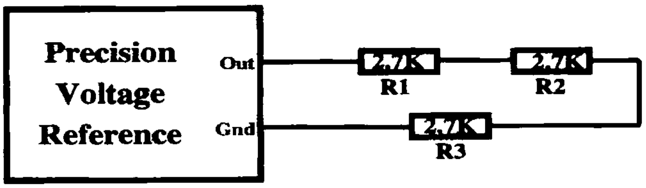


Figure 4. Output voltage vs. supply voltage.



Measure Voltage Across Each Resistor And Sum

	ALFA 2360	Beckman 300	RS 22-188
VR1	1.649	1.649	1.638
VR2	1.679	1.678	1.667
VR3	1.677	1.677	1.665
Sum	5.005	5.004	4.970

Figure 5. Comparing digital voltmeters.

Conclusion

The AD586 chip makes an easy-to-build, high-precision voltage reference. The unit described in this article can be used on the workbench or in the field. Those needing a voltage reference for aligning or calibrating new test equipment or verifying purchased equipment will find this unit a good investment of time and effort. When you need a voltage reference, there is no substitute for a good, known-precision unit. ■

Going Beyond the Last Digit

It is possible to obtain readings with greater resolution than that of the last digit of your DMM. The technique depends upon the idea that the DMM is similar to a digital counter and as such has an input gate counting a series of input pulses. Both the input gate and the series of input pulses are repetitive, but not necessarily synchronized. That means a particular pulse near the end of the input gate will sometimes make it into the count and sometimes will not. Careful logic and reasoning about the events will show that if the last input pulse makes it into the count half of the time, the true measurement will be halfway between the lowest and the highest digit shown in the last place of the count. Thus, if a measurement reads, for example, 2.548 half of the time and reads 2.549 for another half, the true measurement is halfway between those two values, or 2.5485. This is equivalent to taking a time average of the readings. Likewise, if the reading is 2.548 about a quarter of the time and 2.549 the remaining three-quarters of the time, the true value is close to 2.5487 or 2.5488. If the DMM were connected to your computer so that all the values over a minute could be averaged, you could determine a value that was at least one greater order of magnitude in resolution. In other words, you could easily measure one digit beyond the resolution of your DMM. This is theory, of course, and other factors also affect the limits of resolution.

As a practical measure, you can use a timer and simply measure the cumulative time the last digit is a particular value over a period of time. The percent time is then an indicator of the next digit beyond that on the display. For example, if your measurement is 2.548 for 48 seconds out of one minute and the other reading is 2.549 for 12 seconds, then the value beyond the last digit should be 12/60 = 0.2. The true value then would be 2.4582.

Note that this does not improve the accuracy of your meter. It simply lets you make measurements with greater resolution. This can be important when two voltages have to be exactly the same value, or in measuring the difference between two voltages. A better DMM would be the preferred method, of course, but this technique will provide improved resolution when no other means are available.

Transformerless Amplifier

Putting an old twist on new technology.

by Robert W. Vreeland W6YBT

Recently I became the proud owner of an MFJ-9020. It puts out 3 watts when powered by an Edlic TD626 12-volt regulated supply (Edlic Electronics, 2700 Hempstead Turnpike, Levittown, NY 11756-1443). My thoughts then turned to increasing the output. Having previously experimented with high voltage MOSFETs, I decided to build an amplifier using a pair of 600-volt Supertex VN0660N5s (SuperTex Inc., 1225 Bordeau Drive, Sunnyvale CA 94088-3607).[1 2] The result was a 20-watt amplifier that weighs just two pounds, including the power supply. It puts out a clean signal without objectionable clicks or hum. The power supply is transformerless, and puts out 140 volts DC at 350 mA.

Transformerless operation was popular in the days of AC/DC vacuum tube receivers. These radios invariably came in carefully insulated plastic cases. After all, there was no transformer to isolate the operator from the 120-volt line. Our amplifier is housed in a 4" x 6" plastic card file box. The panel and the chassis were cut from a 0.10"-thick sheet of Bakelite. All controls are plastic. Even the tuning capacitor has an insulated shaft coupling. The RF input and output connectors are isolated from the high voltage circuits by Teflon-insulated RF transformers and by careful parts layout. Even so, the RF connectors should be grounded via the third wire in the power cord. A screw connector is provided for this purpose. Obviously, an AC-hot antenna is something that must be avoided at all costs. The amplifier was designed so that all adjustments (including setting the bias) could be made without removing the unit from its case. If out-of-case testing must be done, an isolation transformer (Triad N-54M or Stancor G15-150) must be inserted between the power source and the amplifier. This is definitely a project for the experienced builder who likes to do his own parts layout.

"This is definitely a project for the experienced builder who likes to do his own parts layout."

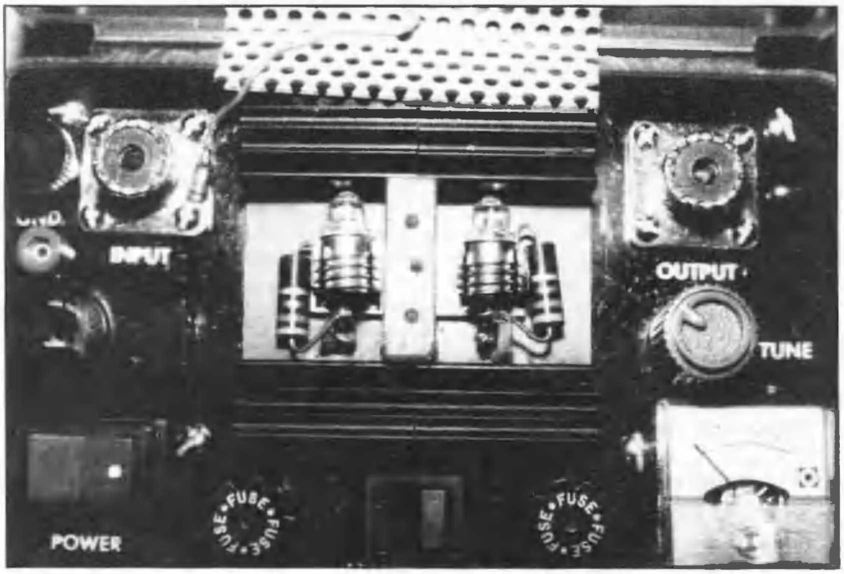


Photo A. Lamps mounted in fuse clips are used for balancing the MOSFETs. Note the neon bulb RF indicator and the overcurrent LED at the right of the RF output connector. The RF connectors and the perforated aluminum heat-sink cover are grounded for safety.

The MOSFETs

An SCR crowbar protects the MOSFETs against a bad antenna mismatch. Operating with no antenna at all simply blows the 1/2-amp fuse (F2).

The method of balancing the push-pull MOSFETs is unusual. The manufacturer specifies that the gate voltage needed to turn them on may be anywhere between 2 and 4 volts. This is typical for high voltage MOSFETs, regardless of who makes them. Consequently, a separate bias trimpot is needed for each transistor. A positive bias is required. The trimpots are accessible through small holes in the panel. A matched pair of #222 flashlight bulbs is used to indicate whether the transistors are balanced. Each lamp is shunted by a 6.8-ohm 1-watt resistor (R14 and R15) and inserted into the source lead of the MOSFET. The lamps are mounted in fuse clips under a grounded cover on the top side of the panel. The trimpots are adjusted for equal lamp color at 20 watts output. They control the amplifier output, in addition to balancing the circuit.

We used our Weller model 8100 soldering gun and Variac to select a matched

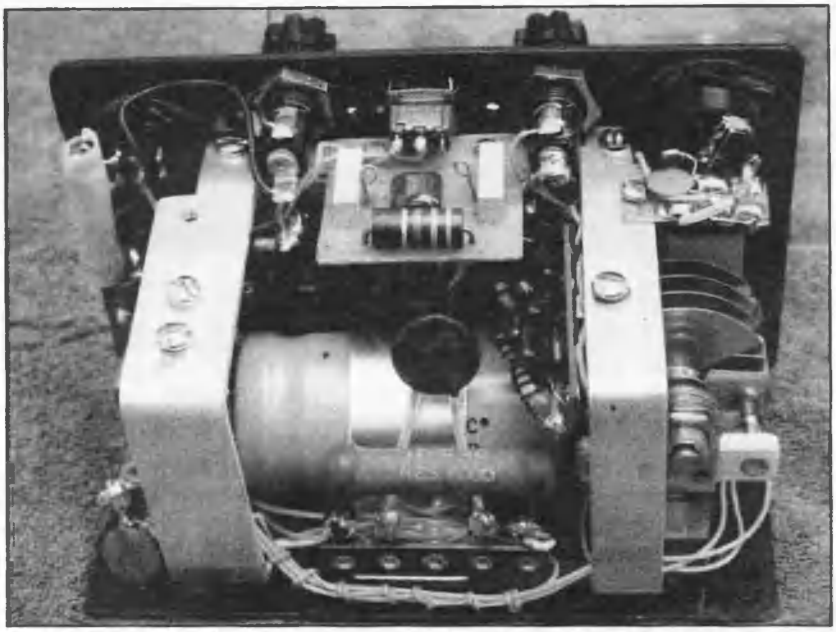


Photo B. The bias supply and trimpots are on the board between the fuse holders. At the right above the tuning capacitor is a little board for the output meter components. The RF output filter is mounted on the right-hand aluminum bracket.

pair of lamps. The 8100 uses two lamps connected in series. The lamps stay in the amplifier circuit at all times. At 20 watts output the filaments are tiny orange dots. Be sure to start with the trimpots set at zero bias. A switch decreases the drive to the amplifier to permit antenna tuning. Alternatively, the MFJ-9020 can be used barefoot for this purpose.

Power Supply

The power supply is a conventional bridge rectifier with a few unconventional changes. Good filtering is provided by a 1,200 µF, 200-volt electrolytic (C5). Without inrush limiting, this capacitor would probably burn out the power switch. We therefore added a Keystone CL-60 inrush limiter (R1) obtained from Hosfelt (Hosfelt Electronics Inc., 2700 Sunset Blvd., Steubenville, OH 43952-1158).

A pair of Radio Shack 273-102A chokes (RFC1 and RFC2) and 0.005 µF capacitors on all legs of the bridge complete the line filter. Without line filtering, the RF radiated by the power line had bad 120-Hz modulation introduced by the bridge rectifier. Be sure to get 273-102A chokes if you can. The newer 273-102B units have a two-layer winding and far too much shunt capacitance for use on 20 meters. If you must use them you will have to completely rewind them with a single layer of wire. Since a fully charged filter capacitor presents a formidable health hazard, a 6k-ohm 10-watt bleeder (R3) was added to discharge it when the power is off. We chose a 6-amp bridge rectifier because of the high inrush requirement. A second CL-60 was added to limit the load fuse-blowing current.

Amplifier

The amplifier is a tuned push-pull circuit. This reduces harmonic output, es-

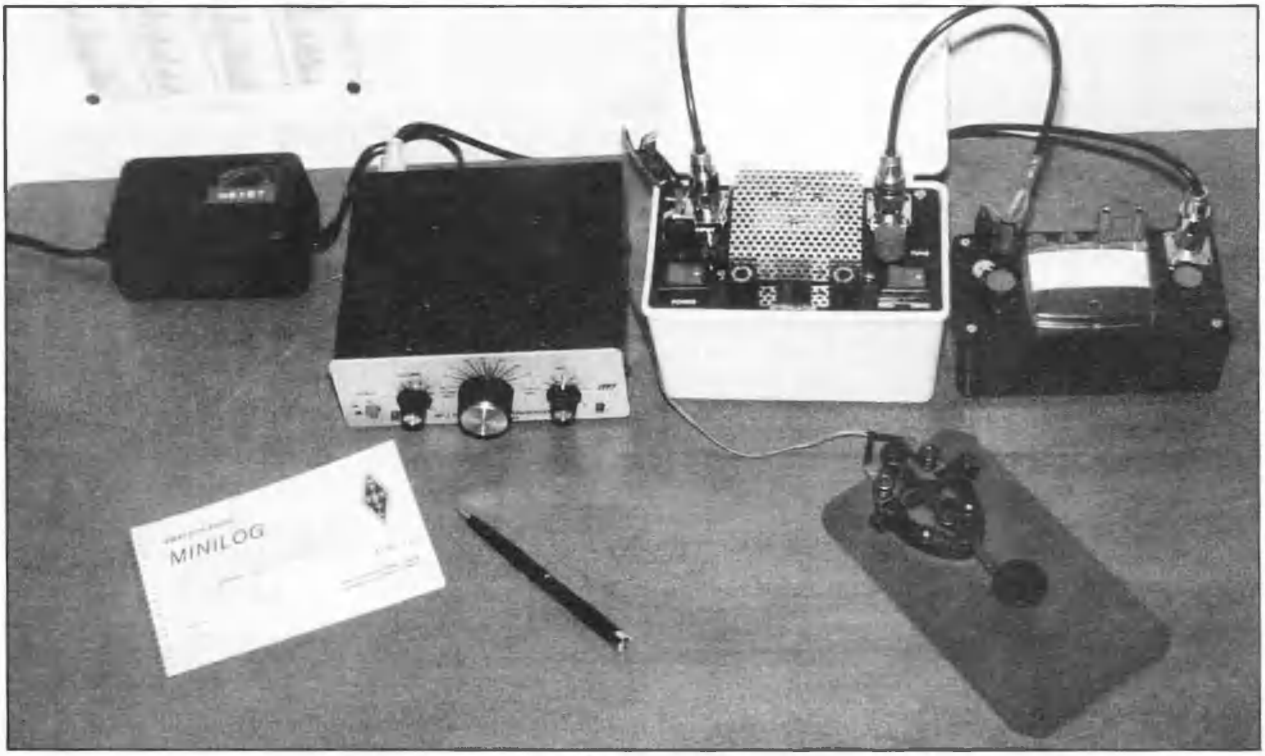


Photo C. The complete station.

pecially the second harmonic. To be on the safe side, we added a low-pass filter taken from page 198 of the 1975 *ARRL Handbook*. Approximate neutralization is provided by a pair of 10-pF 1-kV ceramic disc capacitors (C18 and C19).

We initially had a problem with VHF parasitics. This was solved by inserting two Amidon ferrite beads in each transistor gate lead (Amidon Associates, 12033 Otsego St., North Hollywood, CA 91607), and by installing RFC4. Approximate tuning is provided by a matched pair of 270-pF 500-volt silver mica capacitors (C15 and C16). If possible, use the larger, older type. High voltage polystyrene capacitors would be even better if available. After all, silver mica is not as low-loss as one would hope.

A Hammarlund MC-20-SX 20-pF variable (C17) is used for tuning. These capacitors are still available from Cardwell (Cardwell Condenser Corp., 80 East Montauk Highway, Lindenhurst, NY 11757). The 50-pF MC-50-5 would be a better choice, if available.

Output/Input

The output tuning peak is broad but definite. A sharp peak would indicate undesirable regeneration.

The output transformer (T1) was made by close-winding 10 turns of #20 enameled wire on an Amidon T68-6 core. Number 22 Teflon-insulated hookup wire was used for the two-turn output link. The extra wire was twisted to form a twisted pair transmission line to the low-pass filter. Careful insulation of the output transformer is mandatory. The input transformer (T2) has a 14-turn #24 enameled center-tapped winding. It is close-wound on an Amidon T37-6 core. The primary is eight turns of #24 enameled wire. This wire is threaded through a length of

CIRCLE 15 ON READER SERVICE CARD

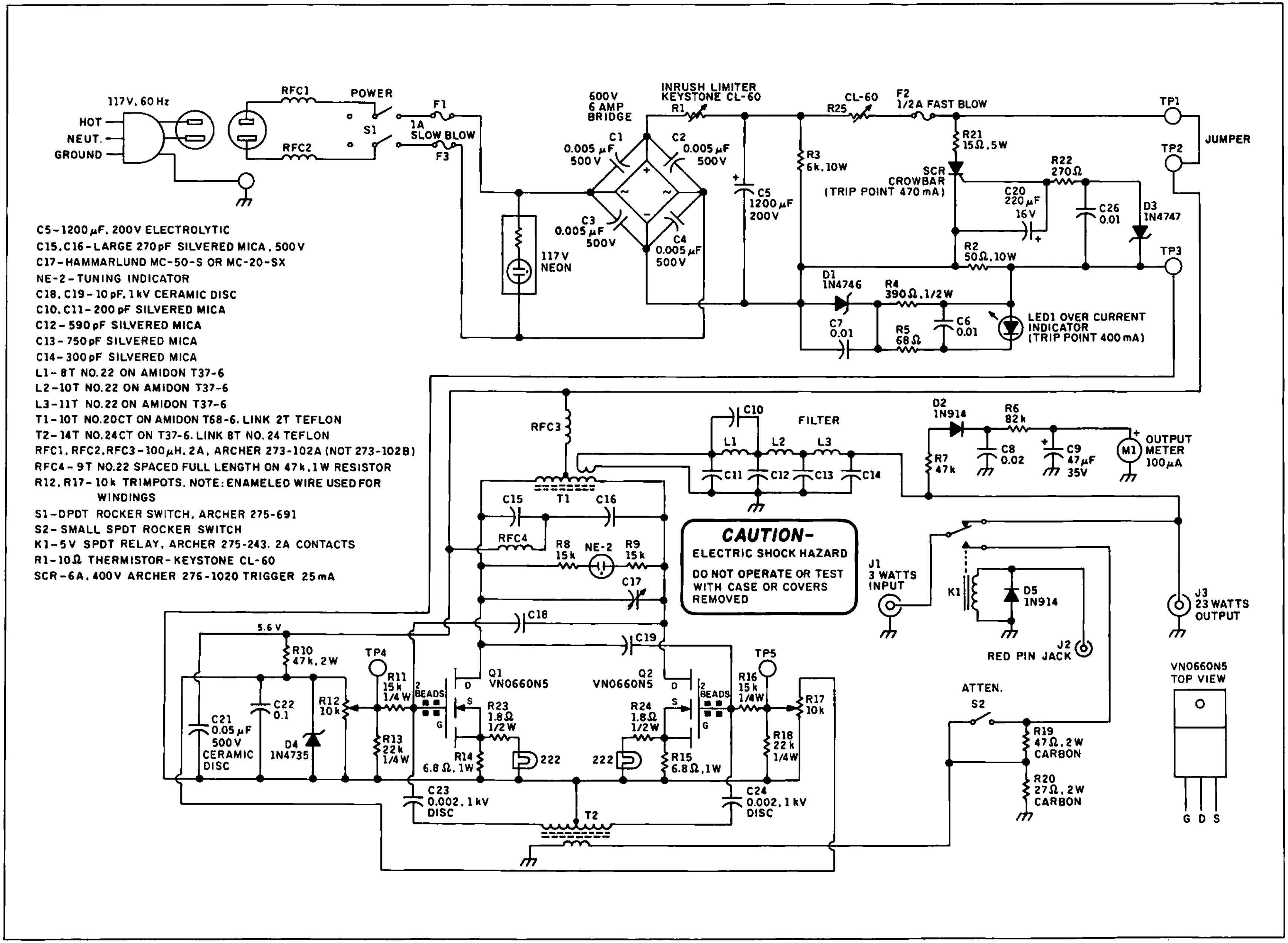


Figure 1. The amplifier uses a tuned push-pull circuit with crowbar mismatch protection. RF transformers isolate the input and output from the high-voltage circuits.

Teflon "spaghetti" before winding. Again, careful insulation is a must.

The input is via RG-178B/U Teflon-insulated miniature coax. A divider consisting of a couple of 2-watt carbon resistors (R19 and R26) reduces the drive to permit tuning. A rocker switch (S2) jumpers R19 for full power output with 3 watts of drive. If the amplifier is to be driven by a 5-watt signal, a 27-ohm 2-watt resistor should be inserted in series with S2.

A terminal block (TP1, TP2 and TP3) was included to permit metering when an isolation transformer is used. The milliameter terminals (TP1 and TP2) are normally jumpered.

A 50-ohm, 10-watt current sampling resistor (R2) provides the control voltages for the 400-mA over-current LED, and for the SCR crowbar. At 470 mA the SCR connects a 15-ohm, 5-watt resistor (R21) across the DC supply. This blows the 1/2-amp fuse (F2) and saves the MOSFETs.

The Completed Unit

Photo A was taken with the cover removed from the heat sinks. They are bonded together but not grounded. The photo does not show the 1.8-ohm peak current limiters (R23 and R24) which were added later. Bias adjustment is done through the small holes adjacent to the RF attenuator switch, using an insulated alignment tool.

Photo B shows the 1,200-µF filter capacitor, its bleeder and the inrush limiter. The bridge rectifier and the terminal block are hidden behind the left-hand aluminum bracket. The bracket supports the crowbar components. Note the Fiberglas-insulated AC line filter choke in the upper left. The major RF components are on a hidden Fiberglas board. The RF input divider (R19 and R20) is at the left-hand end. Next is an unused section for high-voltage insulation. Then come the input transformer (T2) and the parasitic choke (RFC4). The output transformer (T1) and the tank circuit capacitors are at the right-hand end. The MOSFETs are mounted on the underside of the heat sinks, using mica insulators. A Lucite block supports the tank tuning capacitor. Other blocks hold the panel and the circuit boards. ■

References:

1. Vreeland, Robert W., W6YBT, "Notes on a Lightweight Portable CW Transmitter With a Transformerless Power Supply." *QEX*, June 1988, pp. 11-13.

2. Vreeland, R.W., "More Gadgets for Your MFJ-9020." *73 Amateur Radio Today*, October 1993, pp. 10-12.

Parts List

C1,C2,C3,C4	0.0047 µF disc
C5	1200 µF, 200 V electrolytic
C6,C7,C26	0.01 µF disc
C8	0.02 µF, 500 V disc
C9	47 µF, 35 V electrolytic
C10,C11	200 pF silvered mica
C12	590 pF silvered mica
C13	750 pF silvered mica
C14	300 pF silvered mica
C15,C16	Large 270 pF silvered mica
C17	Hammarlund MC-505 or MC-20-SX
C18,C19	10 pF, 1 kV ceramic disc
C20	220 µF, 16 V electrolytic
C21	0.047 µF, 500 V disc
C22	0.1 µF, 100 V mylar
C23,C24	0.0022 µF, 1 kV disc
D1	1N4746 zener
D2,D5	1N914
D3	1N4747 zener
D4	1N4735 zener
F1	1 amp 3AG slow blow fuse
F2	1/2 amp 3AG fast blow fuse
J1,J3	UHF jacks
J2	Red pin jack
K1	5 V SPDT relay (Archer 275-243)
L1	8 turns #22 on Amidon T32-6 core
L2	10 turns #22 on Amidon T37-6 core
L3	11 turns #22 on Amidon T37-6 core
LED1	Red LED
M1	100 µA, 1/14"-square meter (DI-935)
NE-2	NE-2 neon bulb
Q1,Q2	Supertex VN0660N5 MOSFETs
Bridge	600 V, 6 A bridge rectifier
R1,R25	Keystone CL-60 10 ohm inrush limiter
R2	50 ohm, 10 watt, wire-wound
R3	6000 ohm, 10 watt, wire-wound
R4	390 ohm, 1/2 W, 5%
R5	68 ohm, 1/4 W, 5%
R6	82k, 1/4 W, 5%
R7	47k, 1/4 W, 5%
R8,R9,R11,R16	15k, 1/4 W, 5%
R10	47k, 2 W, 5%, carbon
R12,R17	10k, 10-turn trimpot (board-mounted)
R13,R18	22k, 1/4 W, 5%
R14,R15	6.8 ohm, 1 W, 5%, carbon
R19	47 ohm, 2 W, 5%, carbon
R20	27 ohm, 2 W, 5%, carbon
R21	15 ohm, 5 W wire-wound
R22	270 ohm, 1/4 W, 5%
R23,R24	1.8 ohm, 1/2 W, 5%
RFC1,RFC2,RFC3	100 µH, 2 amp (Archer 273-102A)
RFC4	ST #22 spaced full length on 47k, 1 W carbon resistor
S1	DPDT rocker switch (Archer 275-691)
S2	Small DPDT rocker switch
SCR	6A, 400 V (Archer 276-1020) 25 mA trigger
T1	10 turns #20 center-tapped on Amidon T68-6 core Link is two turns #22 Teflon-insulated hook-up wire
T2	14 turns #24 center-tapped on Amidon T37-6 core Link is 8 turns #24 Teflon tubing
Case	4" x 6" plastic card file box
Panel and chassis	1/10"-thick sheet Bakelite, fastened together with Lucite block

The Octopus

A simple multipurpose testing device.

by Craig Faith KB5RMZ

Everyone likes to save time and effort, and amateurs are certainly no exception. This little circuit has become invaluable around my shack when the need arises to do some quick troubleshooting.

It's called an "octopus," an obvious name once you see one hooked up in all its tangled-cable glory, and is available commercially in varying degrees of complexity and price. This is the simplest version I have found, and it was sketched out for me by some shipmates in AIMD, while serving aboard *USS Forrestal* in 1977. Its main attraction is the ability to quickly test a wide range of components and conditions, without changing switches or test instruments.

The unit is designed to be used with an oscilloscope. Any scope will do, as long as it has provision for an external horizontal input. We aren't going to be concerned with precise measurements, so anything from a $10 flea market special to a thousand-dollar Tek will deliver good results.

The Circuit

The circuit is shown in Figure 1. Resistors can be anything from 1/2 watt to 2 watts, and from 1% to 10% tolerance. The transformer can be any 6.3-volt AC unit. Construction is not critical. The unit can be built into a variety of enclosures, and could even be built into some of the older, large-case scopes. Please remember safe construction practices—no exposed 120-volt AC connections, and fuse the primary side with no more than a 1/2-amp fuse. Use shielded coax for the connections to the channel 1 and external horizontal inputs. RG-62 works very well for this.

With everything hooked up and turned on, and the "+" and "-" test probes not touching, you should be able to adjust the scope for a horizontal straight-line display, extending across half to three-quarters of the screen for ease of viewing. Now, shorting the test probes should give a vertical straight-line display, also extending half to three-quarters of the screen. If not, find and correct the problem.

Test Applications

After testing for proper operation, it's time to put the unit to use. The octopus is a "shotgun" test instrument, used to rapidly test for obvious, simple problems as follows.

Continuity: Touching the probes to a suspect fuse, wire, or other normally shorted circuit should result in a vertical line. Shorted components, such as semiconductors, will also produce a vertical line. Blown fuses, diodes, etc., will cause the trace to stay horizontal.

Resistance: It's possible to test for a moderate amount of resistance with the unit. Pure resistance will display as a line at some angle between 0 and 90 degrees. A high enough resistance will show as an open circuit. Precise measurements are not possible—but we don't care. A 20-ohm resistor should produce a nice slanted line. If it doesn't, drag out an ohmmeter for a closer look.

Capacitance: Our octopus can also test capacitors—again, up to a point. A good low- to medium-value cap will show up as a circle or an oval, depending on the value. Any imperfections in the circular display are indications of a bad or leaking capacitor. Refer to Figure 2A for an idea of what the trace should be. for resistance or capacitance.

Semiconductors: Now we come to the unit's most important use, the area where it really shines. In this age of solid-state everything, a quick and easy way to test semiconductors can save a considerable amount of time. We covered testing for shorts or opens in

Continued on page 57

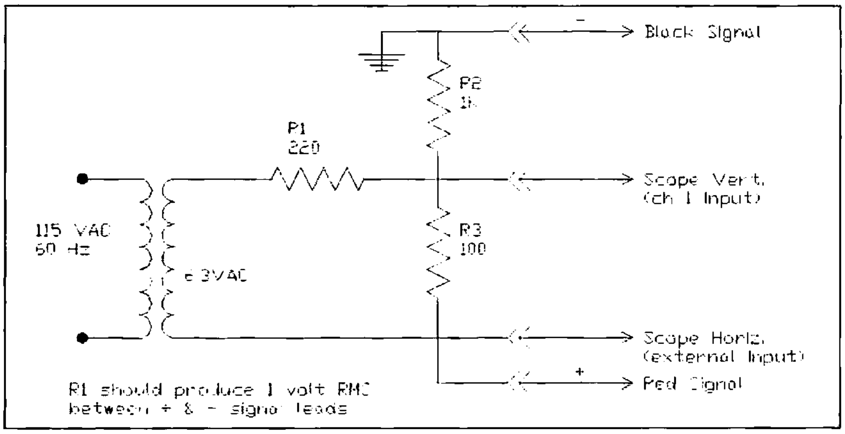


Figure 1. The "octopus" circuit.

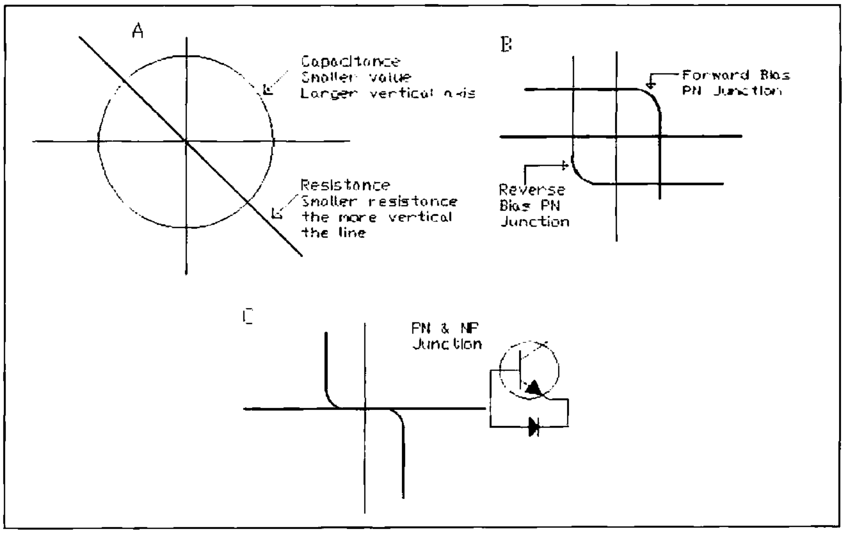


Figure 2. A) Trace for capacitance and resistance. B) Basic semiconductor junction. C) Indication of a simple compound waveform.

ASK KABOOM

Number 17 on your Feedback card

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Wrap Up And Move On

For the past couple of months, we've been looking at the issue of taking measurements, examining the proper use of both meters and the oscilloscope. Let's finish that up.

The Mighty Scope

I've written about the details of scope use before, but a few points bear repeating. First, always remember that what you see on the screen is only a snapshot of a tiny slice in time. Without an infinitely long screen, there's no way you can see a continuous signal. Instead, you see a little fraction of it, repeated over and over for your viewing pleasure. The consequence is that, depending on how you set the scope's controls, you can get pictures of vastly different appearance, even without changing the input signal! Why is that?

Let's Go Cycling

Most signals are repetitive. That is, they have regular cycles, repeating the same waveform over and over, with the only changes being the signals' modulation. That's lucky for us: If they didn't repeat, signals would be darned near impossible to view on a scope. In order for the CRT's beam to trace out an image bright enough to view, it has to hit the same spots over and over. Although many scopes do have "single-shot" trigger settings that let you observe one-time events, they are rarely useful unless the signal and your timebase settings are very slow; you just don't get a bright enough picture if the beam zips across the screen. In a way, you can look at it as a duty cycle issue: you need a small ratio between the timebase setting and the repetition rate of the signal, or too much time passes between sweeps and the phosphor glow dies out.

With a simple signal like a sine wave, the effect of changing the scope's timebase is obvious: Make it faster and the wave stretches out. Slower, and it gets squished together. With a complex signal, though, properly setting the controls can be a confusing process. One of the best examples is a good ol' video signal. If you've messed with ATV, you've probably needed to look at video. Most likely, you had great trouble getting your scope to trigger on the vertical sync pulse. Why? Because the duty cycle is very low; you get one vertical sync pulse for every 262.5 horizontal ones. Also, the vertical pulse is really just a shifting of the duty cycle of the horizontal pulses, making it especially hard to lock onto. Probably, though, you found it easy to lock up to the horizontal pulses. The point here is that, depending on which pulses you chose to lock to, you saw a vastly different depiction of what video looks like! If you've never tried this, get your camcorder and scope, and experiment.

Luckily, most radio signals are usually easier to view, thanks to their simple, cyclical nature. But, with the digital explosion, you may run into long, complex pulse trains which just can't be viewed on a scope. They have special instruments called logic analyzers for that kind of work.

> ***"... depending on how you set the scope's controls, you can get pictures of vastly different appearance, even without changing the input signal! Why is that?"***

Hold It!

Speaking of digital, there's one place in which it can really come to your aid. Digital storage oscilloscopes, or DSOs, get around the repetition problem by digitizing and then storing the incoming signal in solid-state memory. Then, they convert the signal back to analog and output it continuously to the scope's CRT. With a DSO, you can freeze and view even true single events with ease. Many DSOs also let you save the waveform data to a computer. Some even store multiple waveform captures and let you put them up together for comparison on the screen, even though they were not harmonically related. That's something no analog scope can do.

There are limitations to digital scopes, most involving the sampling rate and something called "aliasing," which can fool you into thinking you are seeing something you're not. But, there's no point in my going to great lengths discussing the finer points of DSO operation, because digital scopes are still pretty expensive and consequently rare in ham circles. A few years from now, though, that may not be the case. I hope DSOs become affordable, because I want one!

Frequency

In the old days, all kinds of arcane instruments and techniques were employed to measure frequency, which is not a simple quantity like voltage or resistance. Frequency is, for lack of a better word, a compound measurement, like speed (distance over time). We say "miles per hour" instead of "mours" or "hiles" because there's no simple unit. With frequency, it's cycles per some period of time. We say "Hertz" to honor a great pioneer in this field, but the compound nature of the beast remains, making its measurement more difficult. These days, though, the digital frequency counter has swept all the old stuff away, and with good reason; it's easy to use and stays pretty well calibrated, thanks to its using a quartz crystal as a reference. But, how truthful is your counter?

That depends on the unit itself and how you use it. Any counter is only as accurate as its timebase crystal. Unfortunately, lots of low-priced counters display many digits whose precision far outstrips the basic accuracy of the timebase. So, you may get eight digits, but the last five may not be correct! When you're looking at a nice digital display, though, it can be hard to remember that. We tend to trust what our machines tell us, and many a radio has been misaligned by a well-intentioned technician who, wanting to squeeze the last bit of perfection from it, depended on a highly precise counter that wasn't accurate. The moral is: If your walkie reads 200 Hz low at 146 MHz, *leave it alone!* There's nothing wrong with your walkie, and your counter is probably not telling you the truth. Besides, even if the radio really is 200 Hz low, that's well within spec and will cause no trouble. Of course, if it reads 2 kHz low, that's another story, and one which leaves you with a dilemma; which one is right? Hmmm, no easy answer there, except to get another radio or two and measure them. If they all come out about the same, I'd look sideways at that counter. On the other hand, if they read very close to the right frequency, your HT probably does need adjustment.

Most counters let you select from a couple of measurement periods. The longer the period you choose, the more precision you'll get, in the form of more digits. As long as you understand the precision vs. accuracy issue, you can use that to your advantage. Just don't believe those last couple of digits unless you know the accuracy of the timebase supports them.

Two other issues affect counter accuracy: signal level and noise. Theoretically, the level shouldn't have any effect at all; as long as the signal trips the input stage of the counter, you should get a correct reading, within the limitations of the instrument. I haven't found that to be completely true, however. In my experience, too low a level allows little signal modulations from hum or noise to cause the tripping of the input stage to be intermittent, as the signal dips and rises around the threshold level of the instrument. The result is that you may see a slightly lower frequency than you expect, which could lead you in the wrong direction. Remember, a counter only records how many times its input is tripped during the measurement period; if some pulses are missing, it doesn't know that. I've run into this many times with low-level crystal oscillators. The tip-off is that the less significant digits wander around; especially with a crystal-generated signal, they should stay put pretty well, with perhaps only the last one wandering a little bit.

Noise can have just the opposite effect. If it's strong enough, it can add extra trips, resulting in counts that are too high. The clue's the same, though: the reading wanders. See, even counters can get messy!

Reactance

There are various devices to measure capacitance and inductance. Some come built into digital meters, and there are meters made just for the purpose. You can also get inexpensive kits that convert those reactances to a voltage readable on a voltmeter. Pretty much all the schemes rely on oscillators or flip-flops whose time periods are altered by the unknown quantities and then integrated into a voltage. The technique works very well, but the analog nature of the process suggests that it isn't as accurate or stable as a direct measurement of voltage, which concentrates all the accuracy in one state: the A/D converter. Of course, if the oscillator is very stable, accuracy should be quite good.

Well, there are other kinds of measuring devices, from dip meters to bridges to transistor gain testers to spectrum analyzers. But I think that we've covered most of what you're likely to use on a frequent basis. I hope you've enjoyed this topic. Next time, something different! Until then, 73 from KB1UM.

Octopus

Continued from page 55

continuity, but we can do much more with solid-state devices. Touching the leads across a diode or any two legs of a transistor results in a display similar to that of Figure 2B. This is a representation of a basic semiconductor junction. As with the capacitor display, any interruption in the smooth curve indicates a problem with the device being tested. Unknown and grab-bag components can also be identified as "P" or "N" types by observing the direction the junction breaks. Finally, it is possible to do rough matching of transistors by matching the displayed curves.

Doing in-circuit testing can result in some fairly complex waveforms being displayed. This is especially true if there are ICs in the circuit under test. Opening up a leg of the circuit to isolate the component under test is sometimes the only way to get a good reading.

The best way to learn about and become familiar with the unit is to play with it. Get a handful of known good parts and test them, observing the traces that each generates. Get some scrap printed circuit boards and start poking around. Figure 2C shows an indication of a simple compound waveform that can occur with multiple components when testing in-circuit. You can even try reading integrated circuits with it—depending on the chip, some fairly complex waveforms can result.

I would caution against trying to measure such things as MOSFETs, GaAsFETs, or IGFETs. These are very sensitive devices, and even the approximately 1 volt AC that the octopus uses for its tests might be too much for them.

I hope this little gadget proves to be as useful, and as much fun, for you as it has been for me. Again, the important point is to use it. With use you'll discover even more ways to save time and effort, time better spent on the air rather than in the radio.

Note: With the 220-ohm resistor at R1, the voltage across the test leads is closer to 2 volts AC. This is acceptable, but a value of approximately 680 ohms will drop it to the 1-volt level.

Originally printed in the Arkansas Regional Club Newsletter.

CARR'S CORNER

Joseph J. Carr K4IPV P.O. Box 1099
Falls Church VA 22041

Low-Voltage DC Power Supplies II

Here we go again, continuing our discussion of low-voltage, low-current DC power supplies. These supplies are used for the wide array of gidgets and gadgets that hang around ham shacks and SWL listening posts, as well as electronic hobbyist workbenches. In this month's installment, we will look at the circuit for a variable output DC voltage regulator, and some primary switching circuits for the input end of the power supply.

Variable Output Voltage Regulator

The voltage regulators that we looked at last month were fixed output devices. They have one output voltage, and are not adjustable for other voltages (although certain circuit tricks can modify the output voltages, they are not recommended). However, the LM-317 and LM-338 devices are useful for a variable output voltage regulator. Figure 1 shows the circuit for both forms of voltage regulator.

The key features of this circuit are the same as for the previous circuit: C1 is the filter capacitor, and should be rated at 2,000 µF/ampere; C2 is used to prevent noise problems and smooth some output variation; diode D1 is used to snub any substrate-damaging dumps from C2 or the external circuitry.

The output voltage is set by resistor voltage divider R1 and R2. The voltage will be:

$$V_o = 1.26 \times [R2/R1 + 1]$$

With the values shown, the output voltage will vary from 1.26 volts to 36 volts, as R2 is varied from 0 to 5,000 ohms. If R2 is made a multiturn precision potentiometer, then it's possible to set the output voltage to a very small tolerance of a desired value.

Switching Schemes

Switching is used to control the input of the DC power supply. After all, some means is needed to turn it on and off (marvelous statement of the obvious!). Figure 2 shows the minimum switching that's necessary: Switch S1 is a single-pole-single-throw (SPST) switch in series with the hot side of the AC power line. A fuse or circuit breaker (CB1) is used in series with the switch. Its function is to open the circuit in case of a catastrophic fault (like a short circuit).

The MOV device is optional, but it's highly recommended. It is a *metal oxide varistor*, and is used to snub out high-voltage, short-duration transients on the AC power line. These are the devices that are used inside those special outlet strips used with personal computers. Residential power lines see transients of 2,000 volts peak, at durations up to 20 µs, several times a day. That's a lot of *stresssssss* on DC power supply components, and could interfere with the operation of circuits (especially digital circuits).

The switching scheme shown in Figure 2 is not the best solution, in my opinion. The problem is that it opens only one side of the AC power line. Hopefully, the hot side is opened . . . but that's not always true. Why? Because AC plugs are often inserted into the outlets backwards, and houses are sometimes miswired (a friend of mine had an apartment that was wired with the switch in the neutral line!). A better scheme is shown in Figure 3. This circuit uses a double-pole-single-throw (DPST) switch to open both sides of the AC power line simultaneously. As a practical matter, you may have to use a double-pole-double-throw (DPDT) switch, but they are easily available.

A relay switched scheme is shown in Figure 4. In this circuit, the two "switches" in series with each side of the AC power line are actualy contact pairs on an electromechanical relay. When the coil of the relay (K1) is energized, it becomes a magnet and pulls the switch contacts closed. Switch S1 is in series with the coil of relay K1, and the S1/K1 pair are connected across the AC power lines. When S1 is closed, relay K1 is energized and the contacts close to apply power to the transformer primary winding. Neat, huh? This circuit can be used to remote control (by wire) the on/off function, or when the transformer primary current is higher than a small, conveniently available switch can handle.

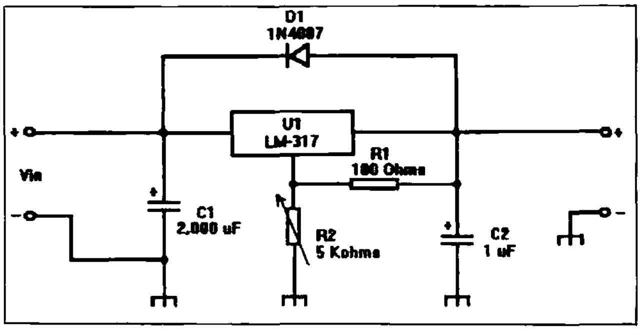


Figure 1. Variable output voltage regulator circuit.

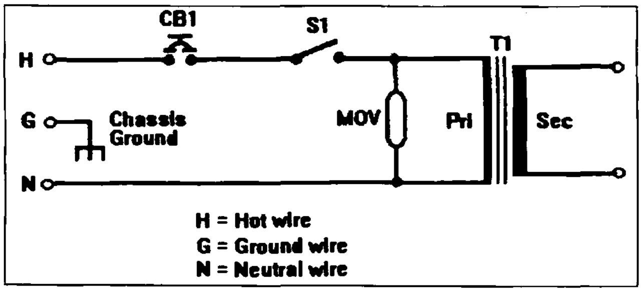


Figure 2. Simplest primary switching circuit.

Filter Capacitor Ratings

The ripple filter in a DC power supply is used to smooth the pulsating DC from the output of the rectifier into something resembling the "pure" DC needed by electronic circuits. These capacitors tend to have high values. For example, in low-voltage DC power supplies the values tend to be 470 to 5,000 µF. In high-voltage DC power supplies, values tend to 8 to 100 µF. These capacitors can store quite a charge.

Capacitors also have a working voltage rating (WVDC). This voltage is marked on the capacitor, and must be heeded. The best practice is to allow a tolerance for variation in applied voltage as well as variation in the real, as opposed to marked, voltage rating.

At one time I worked at a major hospital servicing medical equipment. One brand of bedside patient monitor had a reliability problem with some 60-µF/350 WVDC filter capacitors in a ±200-volt regulated DC power supply. The voltage applied to the regulator was nominally 270 volts, plus or minus 15 percent. This means that the actual voltage could vary over the range 230 to 310 volts. The filter capacitors used were a rather shabby component that had a ±20-percent tolerance on the working voltage. That means the *actual* working voltage rating could be as low as 280 volts. Was the design engineer missing something? That filter capacitor could be hit with a voltage that was 30 volts over its actual rating! The symptom seen, over and over, was either shorted filter capacitors or swollen bodies that indicated a fault in the near future. When we started using 60-µF/450-WVDC capacitors instead, the reliability problem went away. Because of that experience, and the fact that the equipment was

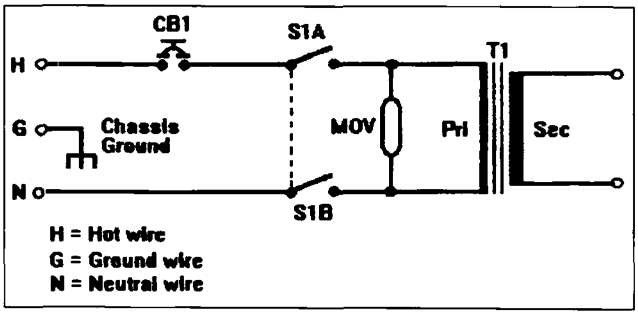


Figure 3. Better switching scheme.

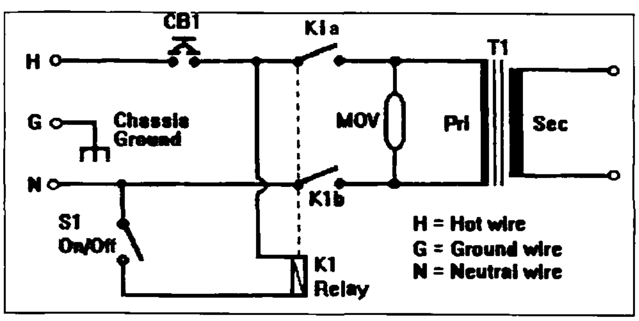


Figure 4. Relay switching scheme.

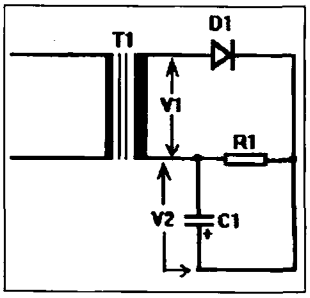


Figure 5. Voltage across the filter capacitor.

Number 19 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21200

A few months ago, I sidestepped a question about using sound boards in your desktop computer for processing RTTY signals. Well, from Alain Bourassa VE2MTV comes the following reply, via Internet:

"I was just reading your June 'RTTY Loop.' I know of those software packages for RTTY, AMTOR, PACTOR, and even packet at 1,200 and 9,600 baud with a sound card. The first thing to know is that those software programs were not written for a Sound Blaster card (the Creative Labs original). They are written for the Cardinal DSP 16 and a few other Cardinal compatible sound boards like the Beethoven DSP.

"This card (the Cardinal board) is Sound Blaster-compatible as well, and this is where the confusion comes from. I bought mine locally fdr $140 Canadian, which could put the cost in the USA at around $70 to $80. This card is not hard to get, but most of the time you have to ask for it, and a vendor will order it for you. It's not the kind of sound card that many dealers keep in stock for regular customers.

"Those sound boards are all equipped with an AMD DSP chip, and Cardinal just asks $39.00 for their software development kit, compared to over $400 for the same kind of kit from Creative Labs. It's easy to understand why Cardinal, even if not as renowned for their sound boards, is the favorite for the software developers.

"It's easy to understand why Cardinal, even if not as renowned for their sound boards, is the favorite for the software developers."

"The easiest file to find is called PSATOR. This is PACTOR software written by an American ham. I also have a packet driver written to be used in JNOS with an 'attach' command that will let the Cardinal DSP 16 act like a DRSI packet board at 1,200 and/or 9,600 baud. This driver was written by a Swiss ham. I also have seen the DSP voice software and a software package for decoding HF WEFAX with a real Sound Blaster (Pro or 16ASP)."

A variety of programs are available for experimentation all over the Internet. One such program, PSATOOL1.ZIP, is included on the latest edition of the "RTTY Loop" software collection. This is a Cardinal Sound Card (PSA) toolkit, written by Johan Forrer, KC7WW. It contains an updated PSA toolkit as described in "An Adaptive HF DSP Modem for 100 and 200 Baud," *QEX*, November 1994:

SPASM21.EXE—Public domain 21xx assembler (updated);
CLOAD.EXE—Bootstrap formatter;
PSA1.OBJ—Object modules for writing your own "C";
PSA2.OBJ—language applications (large model only);
PSA.H—Header file required to compile "C" applications.

As mentioned above, the complete program, PSATOR, is also available on the latest "RTTY Loop" disk as PSATOR10.ZIP Version Beta 0.10, which replaces beta 0.09A, dated 7/11/94. It enables both AMTOR and PACTOR using a PC DSP sound card. The package contains software for using the DSP chip on a PC sound card to implement an HF DSP modem. This software will only run on PSA-based sound cards. The PSA sound cards contain a three-chip set from Analog Devices that includes an ADSP2115 DSP, memory, and a CD-quality 16-bit A/D-D/A. There are several manufacturers for such cards: Cardinal Pro 16 (and Pro 16 Plus), Orchid Soundwave 32, Western Digital Paradise 16-DSP, Wearnes Beethoven, and Echo Speech. Johan Forrer KC7WW has developed this software and placed it online for amateur use.

Overall, these packages, and others available online, allow one to implement a variety of communication modes through advanced hardware and software techniques. I would be interested in hearing of your experiences with this pathway.

Having addressed one problem, let's see if you all can help out with another one. Arthur F. Jeyes AA3GU sent along the following question:

"Hi. I read your features in *73* magazine, and was wondering if you can give me some help. I use a KAM Plus and an MFJ-1278B for digital communications. However, in an effort to achieve better performance I would like to use a dedicated terminal unit (TU). I have purchased an IRL FSK-1000 (used) and am attempting to hook it up to my Kenwood TS-850 at this time. The information that I have is conflicting, at best. Some information on hookups was included with BMK-MULTY, and other information was included with the FSK-1000. But I can't seem to find a definitive guide to setting up strapping and interconnects to radio/PC. In addition, the FSK-1000 has a daughter board that is not documented in the manual that I have, although il appears to be a factory-installed option.

"Any help you could offer would be greatly appreciated . . ."

I seem to remember a daughter board on an IRL demodulator I had some years back, Art, and it may just represent a factory-installed upgrade. However, I will back off and see if any of the readership have experience with this combination. Your equipment is not that aberrant, though, and I wouldn't doubt at all that someone else may be using a setup similar to yours. Sit tight, and let's see what comes in.

I received a letter from Dr. Anil Kumar Agarwal VU2TRI at the Medical Amateur Radio Society, Agra, India, in which he describes their small ham radio club in the local medical college. With a 386SX computer and several simple programs, they are still unable to copy RTTY with their setup. Anil is looking for some RTTY frequencies for monitoring, simple software, and some kind of club project for a RTTY station.

Well, hopefully, the Baycom schematic printed here a bit ago (June 1995, p. 69) will help meet the desire for a simple home-brew circuit. Many, many folks are using the Baycom package, the software for which is part of the "RTTY Loop" disk collection. A simple, TU-less design, Baycom may be your best bet for a straightforward club project.

While I have sent much of this material to Anil, I will say again for those just arriving, that amateur RTTY may be heard most commonly at or around 3,620 kHz and 14.080 MHz. Commercial RTTY is rarely Baudot, so listening to that is a hit or miss proposition.

I've mentioned the "RTTY Loop" disk collection several times above. Again, for newbies to the "Loop," this is a series of more than ten disks with a variety of programs of interest to the digitally inclined ham. A full list of programs, now including a one-line description of each program, may be yours for a self-addressed, stamped envelope to the above snailmail address, or an E-mail request to one of the E-mail addresses below. The full details of how to obtain the disks is included with the listing. Your comments, questions, and answers to my questions are also solicited. Address me electronically at 75036,2501 on CompuServe, at MarcWA3AJR on Delphi, also at MarcWA3AJR on America Online, and via my preferred Internet address at MarcWA3AJR@aol.com.

---

critical to the patients being served. I developed a preference for the practice of selecting a WVDC rating that is at least 40 percent over the maximum probable voltage that will appear across it.

Safety First

When working on DC power supplies, you may be exposed to high AC or DC potentials that can kill you. In addition, the filter capacitors may retain a charge even after the equipment is turned off. Be very careful around circuits, and don't work them "hot."

One problem with many AC-operated power supplies is that the AC power mains are ground referenced at the service entrance to the house. This means that if you accidentally touch the hot side of the AC power line while grounded, you get the full—potentially lethal—whack! In order to prevent problems like that, I use an isolation transformer on my workbench. These transformers are 1:1 ratio, so will produce 110 volts output when the input is 110 volts. Models are available that have a line cord on the primary side, and a three-pin standard AC output on the secondary side. The volt-ampere (i.e., watts, more or less) rating will let you know how much power can be drawn from the transformer. I use a 2,000-VA (2-kVA) model to power everything on the workbench. I was lucky . . . my isolation transformer was industrial surplus and appeared at a very good price on the shelves of a local electronics distributer (2,000-VA isolation transformers can be pricey, but they can save your life!).

Rectifier Ratings

Figure 5 shows a half-wave rectifier (for simplicity's sake) and a ripple filter, redrawn to allow us to see that the voltage across the capacitor is in series with the secondary voltage of the transformer secondary. On the first positive half cycle, capacitor C1 is charged to very close to the peak voltage provided by the transformer. On the next half cycle, when V1 is negative (reverse biasing the diode), this voltage is in series with V1 (the capacitor voltage). At the AC peak, therefore, the series combination applied to the rectifier is twice the peak AC voltage. Or, in terms of RMS voltage (which is how the transformer's secondary voltage is rated), the series combination of V1 + V2, which reverse biases the diode, is 2 x 1.414 V_{RMS}, or 2.83 V_{RMS}. If you have a 12.6-volt RMS transformer, then, the voltage applied to the rectifier as a reverse bias is 35.7 volts. A diode with a 50-volt PIV rating is a little marginal in this application because the variation of the AC power line can push it up to 50 volts. That's why I would use a 100-volt PIV diode (or higher!). In fact, I tend to use 1N4007 (1,000-volt PIV) for all low-voltage applications (besides, they are cheap in bulk).

Number 20 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
Staten Island NY 10313-0006

It was with the greatest of pride that I introduced the young adults who were this year's speakers at the Dayton HamVention Youth Forum. Each year young people from all across the country (and some from other countries, too) begin getting in touch with me as early as the summertime to be interviewed for the Youth Forum. Although I never like to turn anyone down, it *is* an encouraging sign that many more children have been applying than there are slots available.

Preparing for a successful youth forum the magnitude of the one at Dayton, is a job that requires a great deal of time and effort, starting nine months prior to the event. If you and/or your local ham radio club plan to have a youth forum at a hamfest or other ham radio gathering, you might want to give me a call for some tips that will save you much time.

The children I selected this year each spoke about different aspects of ham radio. I chose children who represented a variety of interests and backgrounds. They were all wonderful! It takes a lot of courage for a young person to get up in a room filled with adults as well as their own peers and deliver a 10-minute speech.

The first up to the podium was Marc Azar N2XEZ from Tom's River, New Jersey. Marc and his dad are both active in ARES. He is 14 years old and enjoys doing emergency communications.

Stefnee Lindberg NØONP is 18 years old with an advanced ticket. She is from Kansas City, Missouri, where her extraordinary work with the Red Cross was documented on a local television show. Stefnee is visually impaired and easily impressed the audience with her determination and enthusiasm. She gave a nice talk entitled "Reasons For Becoming A Ham."

Missy Hollenbeck AAOOF from the Kansas Andover Middle School is a teacher who brought three of her ham radio students with her to the Youth Forum. The day before, Missy was a speaker at my Instructors' Forum where she gave an outstanding presentation. The three youngsters, Sarah Hill AAOTN (age 15), John Dolecek KBØLHG (age 14), and Donovan Metcalf NØUYW (age 15), had along with Missy prepared a delightful 30-minute skit. When the apron and pots and pans came out for a take-off on the SOS commercial on TV, we all knew we were in for a treat.

When each of the three children got to the microphone, he or she spoke about their most exciting adventures in Missy's classes, including Field Day, balloon launching with a cricket on board, packet radio, and lots more. We were trying a new format by letting the teacher be involved in the children's presentation. It was terrific!

Robbie Mehls KBØMAS is 13 years old and is treasurer of the Boulder Amateur Radio Club (BARC Jr.) in Colorado. Robbie was recommended to me by Ellie and Rip Van Winkle, who are two of the elmers doing an outstanding job with children in ham radio. Ellie NØQCX has supplied me with excellent BARC Jr. speakers for the past three years, and is a good example of the influence a teacher can have on the lives of her students.

Robbie was an outstanding representative of his club. His slide presentation of an outing his group went on into the Canyonlands of Colorado was breathtaking. The emphasis of his talk, of course, was on the role of ham radio emergency communications when danger arose. It was an excellent presentation.

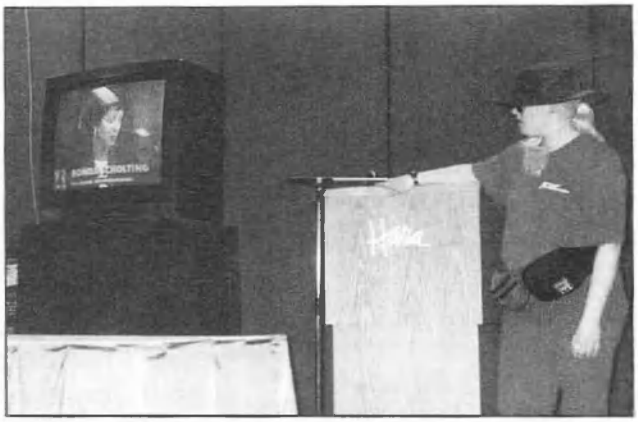


Photo A. Eighteen-year-old Stefnee Lindberg NØONP shows video of her TV coverage.

Don LaFreniere VA3DJL, 16 years old, is from Ontario, Canada. He is the coordinator for his club's ARES net. Don had the group smiling and laughing as he described his search for a radio club composed of other youngsters, but wound up joining the "Retirees" club. His great sense of humor, the video footage of his club activities combined with a musical background, and a description of his accomplishments all made for a wonderful presentation.

Allison Zettwock KD4CKP is 15 years old with an Advanced ticket. She is from Louisville, Kentucky, and was the Westlink-YAESU Young Ham of the Year. Allison spoke about her work with the Girl Scouts, and her aggressive efforts in recruiting other kids. This well-rounded young lady was a delight to listen to.

The next speaker was one of the young people influenced by Allison, Daniel Sturgeon KE4KXB, 17 years old and from Louisville, Kentucky. Daniel is actively recruiting other children by working through the Boy Scouts. He has international amateur radio interests that led him to winning a congressional scholarship to go to Germany to study next year. I made Daniel promise to stay in touch with me about his adventures overseas. We all wish him the best.

Three of the manufacturers were well represented at the Youth Forum, where they generously donated rigs to three lucky youngsters in the audience. Maria Lopez from Kenwood presented Michael Macino KB9IHS with a 22AT rig. Richard Stubbs KC5NSZ, the customer service manager of MFJ, presented Ryan Southwell KE4GEN with a 20 meter SSB TravelRadio. Derek Wyatt, a young man who is now highly motivated to get his license, was the winner of an Icom 2 meter T21A HT. Chris Lougee presented the rig on behalf of Icom. Let's all remember to support the manufacturers who lend their support to education and young people.

It was once again a great privilege for me to be part of the forum that showcases the accomplishments and radio achievements of young hams. 73

Photo B. The group from Andover Middle School did a lively demonstration of their balloon launch.

Photo C. Richard Stubbs KC5NSZ from MFJ presents a 20 meter SSB Travel-Radio to Ryan Southwell KE4GEN

Number 21 on your Feedback card

ABOVE & BEYOND

VHF and Above Operations

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego, Calif. 92119

August is the month for many happenings, but for me it's the opening weekend for the ARRL 10 GHz contest. This is my contest—not that it's mine, but rather that I enjoy so much to be able to go out into the field and hash out all the things that I was supposed to prepare on the workbench in the months prior to the contest. If you're like me, a lot of things are put off till the last minute . . . particularly portable equipment maintenance.

I have put out so many promises in good faith of completing them, I just left my own 10-GHz equipment in the faith that it will operate as it did last year. I saw a sign in the local barber shop that put me back into perspective. "Due to numerous complaints on our free service, all further free services will be canceled." Well, the bottom line is that you can only spread yourself so thin before the bottom caves in. In my case it's not so drastic, but I have to admit I should decrease my dose of amateur-related projects. Well, enough of this psychological self-evaluation—on to this month's topic, readers' comments, and the microwave surplus evaluation, *on the fly*.

Quick Evaluations

There are several tricks of the trade to evaluate surplus material, as I say "on the fly," at swap meets and other events that we microwavers *feed* upon. This month's column will present several different ideas to assist you in making a static evaluation of these bits and pieces. I hope to cover them broadly to make best use of them. I try to practice what I preach, and therefore usually carry in the glove box of the car a suitable set of simple tools to help perform these tests should an opportunity present itself.

The first item I want to cover is a reflection (no pun intended) of last month's column on power meters. I received several comments concerning what to pay for surplus power meters and, most importantly, the RF head and connecting cables. Other questions ranged from what conditions to expect and, especially, how to know if it works. We need a set of test parameters on which to evaluate a device in order to prevent purchasing another *door stop*. We want to avoid the irritation of purchasing a defective power meter. While I can't guarantee you this test will be 100% perfect, it will help to minimize any aggravation.

When you happen upon a power meter at a swap meet or flea market, it's kind of hard to evaluate the meter in its operational state unless you have AC power and a source of RF to fully test it. However, there are some basic tests that you may perform on the unit to determine if it is indeed *alive*.

For an example, I will use the HP-431-type power meter setup with thermistor cord and HP-478-type thermistor mount. This system setup can measure frequencies from 10 MHz to over 12.4 GHz with ease and accuracy using the "N" coaxial connector of the 478A power head. Other heads are available with waveguides rather than coaxial input connectors. The 478A coaxial head is the most popular, as it has the most common frequency range. However, 10- and 18-GHz waveguide heads are very good, also. The frequency of use is limited to microwave in their respective bands of operation only.

Recently I evaluated three power heads with waveguide inputs for the frequency range of 12.4 to 18 GHz and found only one suitable purchase. I also applied the same techniques to evaluate seven coaxial General Microwave power heads and found them all defective. They all carried sticker prices of $40 each—not too bad for a door stop. Just don't let your pick-up-itis get in the way of reason; evaluate what you are contemplating purchasing.

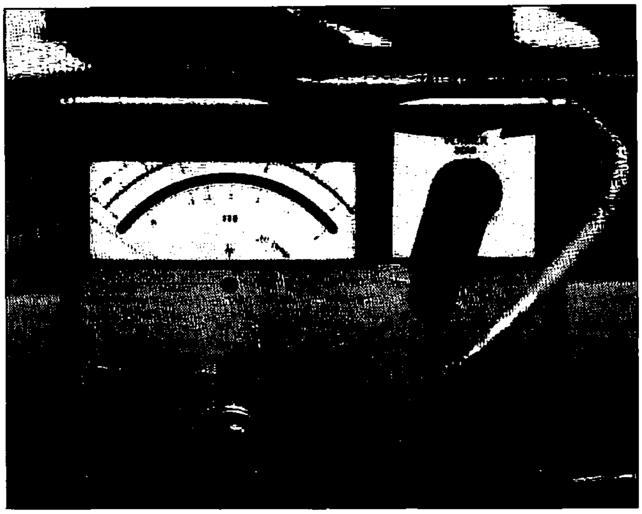


Photo A. HP-431c power meter with 478A power head and cord.

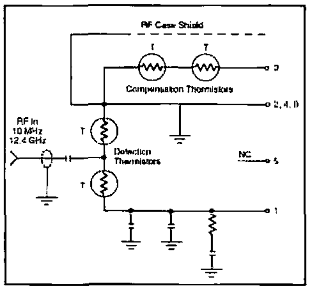


Figure 1. Hewlett Packard 478A power head diagram.

The cost of a complete power meter package with cord and thermistor mount should be less than $200 dollars. I have seen systems go for a lot less, $125 or so being more commonplace. As far as individual value goes, the basic meter HP-431 is valued at about $20 to $25, as there are a lot more meters around than cords and the scarce thermistor heads. The RF cord is valued at $20 to $40 each with the bulk of the value in the thermistor head itself. Thermistor heads can go for $80 to $100, depending on condition (appearance). Used good-but-grungy heads demand the lower figure, while new heads take top price.

Evaluation at swap meets can be difficult, but if there is AC power, you can plug in the meter and see if you can make DC balance with the RF head attached. (Set the meter's resistance switch on the front panel to 200 ohms when using the 478A RF head.) Adjust the meter balance controls for zero indication, using both the coarse and fine balance potentialities. If a power meter will balance, it's usually in reasonable condition. While in the AC power mode, pull out your little RF test generator to make an on-scale reading. (It's a single TTL high-frequency crystal oscillator module, powered by a 9-V transistor radio battery. The unit I built is quite small and uses only eight components: a crystal oscillator module, a 9-volt battery, 5-volt zener with load resistor, three resistors in the output attenuator circuit, and the on/off switch.)

If AC power is not available, you can still test several conditions to confirm if indeed you have a bargain. What we want to determine is whether the RF thermistor head is *alive*. To accomplish this we make a DC resistance check of the thermistors in the 478A thermistor mount. For this measurement, you need an older-style POVM (Plain Old Volt Meter) or, more exactly, a nondigital-type VOM. The new digital types work, but with autoranging you don't get repeatable results. What is desirable is a range setting like x10 that does not provide high current output like the x1 scale, or the higher voltages used when in the megohm ranges. The times ten scale of an analog resistance meter (VOM) is perfect.

Make a DC resistance check between the shell (ground) of the HP-478A thermistor head and the pins that would connect to the meter's cord. You will find one pin open and three pins connected to ground. The remaining two pins are direct connections to the thermistor leads. One thermistor is the actual RF thermistor that responds to RF power, and the other is isolated and is used to provide balanced temperature stability to the bridge circuit. Both

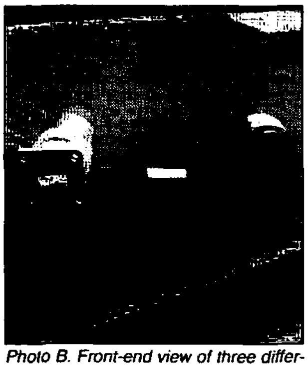


Photo B. Front-end view of three different power heads. Left and center: 12-18 GHz and 8-12 GHz waveguide types. Far right: 478A coaxial 10 MHz to 12 GHz.

Photo C. Side view of the 18-GHz (left) and the 10-GHz (right) RF power meter heads.

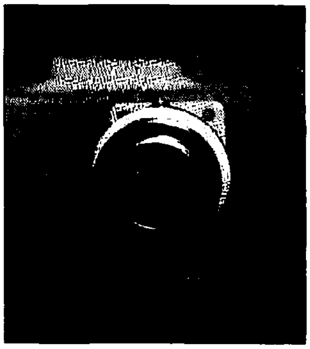


Photo D. Rear cable end connector. Note similarity on pin-out arrangement to Motorola microphone connector.

thermistors must be matched in order to be able to balance the power meter bridge circuit.

Now what follows is not a Hewlett Packard's thermistor selection process, but rather a simple, quick, and easy-to-perform DC resistance check I use without AC power or other evaluation methods available. The resistance of each thermistor should be quite close in relationship to the other. Nominally, I have made readings near the 1,000-ohm range using a 1,000-ohm-per-volt VOM, a Radio Shack $10 special. The specific resistance is not important, just that the thermistors are in the range of 1,000 ohms. What is critical is the match between the two thermistors. I have observed some power heads thermistors read 758 ohms and 786 ohms, 1,320 ohms and 1,285 ohms, 956 ohms and 984 ohms. Others I have tested all showed readings within less than 5% or so of each other. If this match is quite close the head should work. Out of 25 or so heads verified in this manner only 2 showed problems. One was temperamental in that it showed instabilities as if it were a microphonic connection. The other one was 5 dB off in calibration and not linear. The others units evaluated out of a batch of some 75 heads (considered over many years) were not suitable for further evaluation. Most were with one thermistor open or the match was quite bad.

Examples of Bad Thermistor Heads

A bad or defective thermistor head is one with a thermistor open, usually the RF-detection thermistor. In a HP-478A mount, the maximum RF power to be detected is 10 mW, and I suspect that *10 watts* or some such excessive power caused the thermistor to go up in smoke. Usually the RF head will handle an over-range input of +20 mW for a short time, but you are "ticking the tail of a dragon" if you try.

Over-range input power also causes matched thermistors to heat up excessively and change their resistance values, ruining the previously matched set by excessive RF heating. Checking the thermistor heads in this case you might obtain DC resistance readings like 1,130 ohms and 910 ohms. The result is a head that will not zero calibrate and is considered smoked just as much as one that is open, for all practical purposes. When this happens you will not be able to balance the meter.

No matter what you do, that head is useless. The resistance must differ less than 50- to 100-ohms to be able to bring the HP-431 power meter to balance. See Figure 1 for pin out connections on the HP-478 power head.

This pin-out is the same for many manufacturers other than Hewlett Packard. I suspect most are authorized replications made under contract to HP, carrying other designators but physically identical to the HP-478A thermistor heads. Most were manufactured by Struthers. Recently I picked up an 18-GHz waveguide head that was manufactured by PRD, strikingly similar to the HP types. Even the connector seemed identical, so I tried the old POVM meter I carried in the car glove box and put it to a test. It was the only one of the three I previously described that tested good on the ohmmeter.

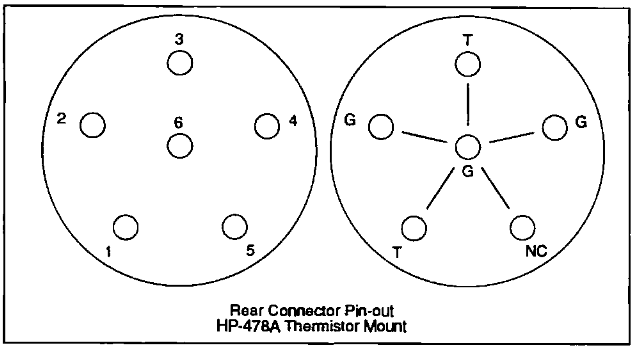


Figure 2. Hewlett Packard 478A ohmmeter check points.

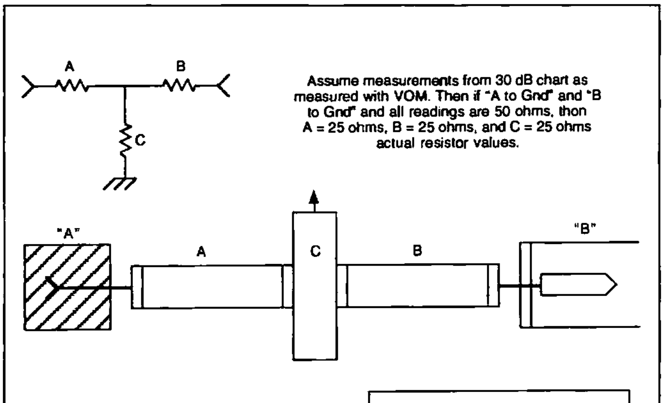
One other unit tested with both thermistors showing continuity, but their resistance readings seemed at the edge of my tolerances. I talked the surplus store into letting me take the two heads on *credit*, to be returned that day if a home test proved them incompatible with the HP meter system. Well, I am happy to report that the PRD head that tested within close tolerance did balance and reads quite accurately. The other head that seemed to be at the edge of my tolerances would not balance and was returned to the surplus store. I avoided making a costly mistake again.

Terminations and RF Attenuators

The other components needed to make good power measurements into the microwave region are a good set of variously valued attenuators. Usually a set includes 3-, 6-, 10-, 20-, and 30-dB 2-watt attenuators, more commonly called pads. Two things are important in selecting and paying a price for a pad. Pads are rated in frequency and attenuation. If you intend to use a pad at 10 GHz, make sure that it is rated to operate at this frequency. Usually the attenuation and frequency characteristics are printed on most pads. If it is not, you on your own as far as frequency is concerned. I have had some very high quality pads that looked top-of-the-line, but in performance they became screwball and nonlinear as to attenuation when the frequency increased beyond 6 GHz.

At 10 GHz a particular pad exhibited some 35-dB loss, while at 8 GHz it was 32.4 dB, and at 6 GHz it measured 30 dB. Decreasing frequency, the 30-dB loss remained stable. This showed that the pad was not designed for operation at all above 6 GHz. It did not have any frequency markings or ratings on the pad. I have tested HP pads that are rated to 12.4 GHz, and they're quite good even far above their 12.4-GHz frequency limits.

The other important rating is the loss value. Here we can make some determination if the pad is OK. Enter our handy VOM again. An attenuator or pad is usually constructed in a "T" fashion, giving equal resistance to both the input and output coaxial connectors. The usual construction form is small, cylindrical input and output resistors forming the center conductor of the "T" pad. The shunt, or center resistance to ground, is constructed with a very large diameter resistor connected at its center to the input/output resistors. Circular in design, its outer edges are connected to ground and it acts as a shield between the input and output of the pad. See Figure 3 for construction details.



Resistors "A" and "B" are small tubular resistors with diameters approximating a 50-ohm coaxial transmission line. Resistor "C" is much like a "Lifesaver" shape, grounded on the outside ring and acts as a resistance to the center conductor.

Loss	A to Gnd	B to Gnd	A to B
5 dB	100	100	29
10 dB	64	64	50
15 dB	56	56	74
20 dB	51	51	95
30 dB	50	50	50

Figure 3. Microwave "T" pad construction.

Mailbox Comments

From Donn Baker WA2VOI, concerning WA6CGR's power supply circuit in the January column: "I've been using a modified version of the circuit for more than a year now to provide +24 volts for a TWT on 2,304 MHz when roving. I didn't need the multiple voltage, so don't have to utilize the +20 and -5 volts circuits. I take +25 volts or so at 3 amps continuous from the circuit. The Micrometals T-106-26 (Amidon T106-26) core that CGR uses is far from optimum as the basis for the magnetics. The -26 material is powdered iron, and as such is suitable for a DC choke, or 60-Hz line filter. Its losses are somewhat excessive for use at the 40-kHz switching frequency of the LT-1070. As both WA6CGR and myself are running the LT-1070 at pretty close to its maximum, the losses in the core can be significant. (WA6CGR is drawing about 90 watts, I'm drawing about 75.)

"I originally built my first supply with the T-106-26 and it ran hot. The overall efficiency was about 70%. After I burnt my fingers a couple of times, I replaced the T-106-26 core with an Amidon EA77-500 'E-core.' That core runs cool, and the overall efficiency was measured at 84 % . . . a more than significant improvement. I'm using 30 turns of #18 AWG tapped at 11 turns. This appears to be the same as WA6CGR used on the -26 core. Incidentally, Linear Technologies application note AN-19 talks all about the LT-107X family, and is worthwhile having if you're going to do anything serious with these regulators." Donn Baker, 3128 Silver Lake Road, Minneapolis MN 55418.

Thanks, Donn, for the fine comments and workbench-related tips on working with the LT-1070 switching regulator. Comments like this are very constructive and I like to include them in this column for sharing with our readers. By the way, I started getting into electronics in the Minneapolis area at Washburn Jr. High School through the intervention of a science teacher there. I lived near 64th Street on the edge of what was then (in the '50s) Minneapolis and the suburbs of Bloomington and Richfield. Lots of fond memories.

Well, that's it for this month. As always (10 GHz contest time permitting), I will be glad to answer questions regarding this and other related topics. Please send a SASE for prompt reply. 73 Chuck WB6IGP

HAMSATS

Number 22 on your Feedback card

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

Photo A. Early Mode "S" experiments at WA5ZIB used a 4-ft dish.

New Satellite Modes

Excitement and enthusiasm were high when AMSAT-OSCAR-7 was launched in 1974. The new amateur-radio satellite carried two analog transponders in addition to an advanced telemetry system. The Mode "A" transponder used a 2 meter uplink with a 10 meter downlink. AMSAT-OSCAR-6 had pioneered this mode a few years earlier and had become extremely popular with operators around the world. There were some complaints, though, from the amateur community about the new Mode "B". It required users to uplink on 70 cm and receive on 2 meters. SSB and CW equipment for Mode "B" was in short supply 21 years ago. In time, the advantages of a UHF uplink coupled with a VHF downlink became apparent, and commercial gear more available. Lower noise and more RF spectrum made "B" the favorite.

Mode "S"

When AMSAT-OSCAR-13 was launched, the same complaints surfaced again. This time the focus was on Mode "S". The 70 cm uplink was not a problem, but the 13 cm downlink was considered far beyond the reach of the typical satellite fan. A-O-13 also carried a Mode "B" system like that on A-O-7, a Mode "J" transponder like AMSAT-OSCAR-8 (2 meters up and 70 cm down), and a Mode "L" transponder like AMSAT-OSCAR-10 (23 cm up and 70 cm down). Thanks to the inclusion of Modes "B", "J", and "L", grumbling about the 13 cm downlink of Mode "S" was mild. Most satellite operators simply ignored it.

When the 70 cm transmitter on A-O-13 failed a few years ago, interest in Mode "S" grew. Modes "J" and "L" were no longer operational and additional time was set aside for Mode "S" in the A-O-13 operating schedule. Devoted experimenters were delighted with the expanded opportunity to try their hand at receive-converter design and microwave antenna work, and others began to take notice of this neglected mode.

The A-O-13 Mode "S" transponder was developed as a proof-of-concept project, not as a primary system. The average power output is 1.25 watts to a 9-dBic (decibel, isotropic, circular) helix antenna. This means that when the antenna is pointed at the earth, the satellite provides 10 watts EIRP (Effective Isotropic Radiated Power) with right-hand circular polarization. The 9-dB antenna gain represents a multiplication factor of eight. This output can be used for the beacon signal or the transponder system; both are not active at the same time. The beacon transmits on 2,400.661 MHz and the transponder downlink ranges from 2,400.715 to 2,400.749 MHz. The corresponding uplink goes from 435.602 to 435.636 MHz. The transponder is non-inverting. This means that a USB signal low in the input range will be retransmitted as a USB signal low in the output range.

The Gear

Some amateurs had been active with MDS (Multipoint Distribution System) TV reception around 2155 MHz for a number of years when A-O-13 was launched, and UHF SSB and CW work was no longer uncommon. The jump to narrow-band, weak-signal satellite communications on 2.4 GHz required a union of techniques from both arenas. Better front-end circuitry and stable local oscillator circuits were required in addition to microwave construction techniques. Designing and building such items required esoteric test gear and significant RF design work.

Early receive-converter kits for Mode "S" removed the microwave design requirements, but tune-up and troubleshooting left many would-be "S"-mode enthusiasts with unfinished converter projects gathering dust. Most hams do not have access to spectrum analyzers and test equipment that even approach the frequency range of Mode "S".

Newer "no-tune" converter kits helped considerably. The use of stripline filters directly etched on the circuit boards and the introduction of MMIC's (Monolithic Microwave Integrated Circuits) made the difference. If the circuits in the finished kit drew the right amount of current, they were probably working. Armed with a coffee-can feedhorn and a small dish reflector, the new Mode "S" chaser had a good chance of getting something off the bench and on the air. Packaging the collection of circuits and preparing the antenna for permanent outside operation tended to slow down the process and, for some hams, provided another round of dust-gathering, expensive, closet gear.

COTS

Thanks to the proliferation of microwave circuits for consumer applications like satellite television, the components for simple, high-performance, COTS (Commercial, Off-The-Shelf) S-band ham equipment have become readily available. While kits are still available from places like Down East Microwave, complete ready-to-go receive converters and antennas can now be easily purchased.

The major amateur radio manufacturers have yet to make Mode "S" equipment for the U.S., but other, more specialized firms have created products specifically designed for Mode "S" satellite reception. Four companies that sell 2.4-GHz converters, preamps, and accessories include Down East Microwave, SSB Electronics, Bob Myers Communications, and TGN Nachrichtentechnik GmbH. All of the units convert 2.400–2.404 MHz down to 144–148 MHz.

Down East Microwave sells an assembled version of their converter kit for $255. The front-end noise figure is relatively high, around 5 dB, but coupled with a low-noise preamp, the unit performs well. A waterproof enclosure is necessary if the unit is to be mounted at the antenna. The matching preamplifier sells for $130. The address is 954 CR 519, Frenchtown, NJ 08825, and the phone number is (908) 996-3584.

You can contact the U.S. outlet for SSB Electronics (a German company) at 124 Cherrywood Drive, Mountaintop, PA 18707. Jerry Rodski K3MKZ runs the operation and can be reached at (717) 868-5643 during evenings and weekends. The FAX line is (717) 868-6917. SSB Electronics has been making VHF, UHF, and SHF gear for many years and has three types of converters for Mode "S". The least expensive is the UEK-2000S, which has an SMA input connector and is not weatherproof, but sports a 0.8-dB noise figure. The price is $389.95. The UEK-2000SAT is a mast-mounted, weatherproof version with N-connector input, a noise figure of less than 1.0 dB, conversion gain of 20 dB, and a price tag of $429.95. The top-of-the-line unit, the UEK-2000SAT/01, is similar, except with a 30-dB conversion gain, and sells for $459.95. A preamp is not necessary with these units when mounted near the receive antenna. The SSB Electronics catalog contains a complete line of preamps, power amps, converters, and low-loss coaxial cable. They also stock all of the M-Squared antennas.

A new entry in the downconverter market is Bob Myers Communications. Bob W1XT publishes *OSCAR Satellite Report* and *Satellite Operator* in addition to selling many hamsat-oriented products. Bob's SBDX-2400 remote downconverter comes complete with a wall-mount power supply and DC isolator, allowing the unit to be powered through the coaxial line between the unit and the 2 meter receiver. The advertised conversion gain of the unit is a minimum of 40 dB and includes two stages of 2.4-GHz preamplification. The price is $389.95 plus $12.00 for U.S. shipping and insurance. The address is P.O. Box 17108, Fountain Hills, AZ 85269-7108, and the phone is (602) 837-6492. The FAX line is (602) 837-6872. Bob can also be reached via E-mail at bmyers@primenet.com.

A foreign company of note that produces an array of microwave subsystems, preamplifiers, converters, and components for OSCAR and other satellite pursuits is TGN Nachrichtentechnik GmbH of Germany. They have four versions of Mode "S" receive converters. Each is weatherproof, has a conversion gain of at least 30 dB, and is powered via the coaxial feedline. Every unit is provided with tested noise-figure specifications performed on a Hewlett Packard HP8970B Noise Figure Meter. The prices are based on front-end noise figure measurements. The LNB2400/0.7 (0.7-dB noise figure) sells for 360 German marks. The 0.6-dB version sells for 400 marks and the 0.5-dB model is priced at 445 marks. A 0.4-dB version is available, but for substantially more money, and it has an SMA input connector. The others have N-connectors. A DC isolator (Fernspeiseweiche) is sold separately for 58 marks. The address is Anusstr. 23, D-66957 Ruppertsweiler, Germany. The phone number is 49-6395-8021 and the FAX line is 49-6395-8082. Although the prices look good even at current conversion rates, there is the matter of shipping, which can easily add another 100 marks. Credit cards (Visa and American Express) are accepted.

Photo B. The preamp/converter side of a Mode "S" unit using parts from Down East Microwave.

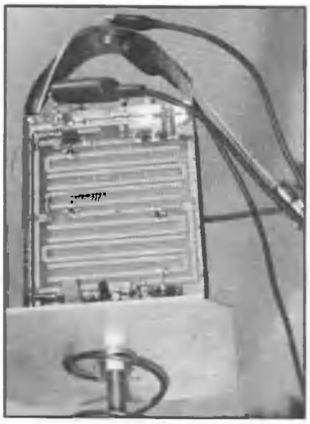


Photo C. The local oscillator side of the Down East Microwave Mode "S" receive converter with a small helix for the dish feed.

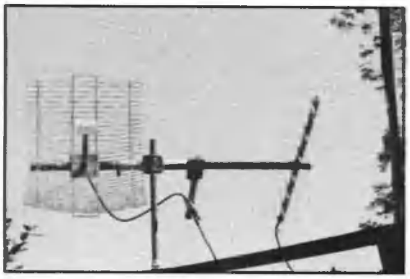


Photo D. Portable Mode "S" array using commercial antennas for the 70 cm uplink and 13 cm downlink.

Photo E. Small Yaesu all-mode VHF and UHF rigs for the portable Mode "S" station.

Photo F. An antenna-mounted downconverter for Mode "S" converts the 13 cm signals to the 2 meter band. This unit is from TGN Nachrichtentechnik GmbH in Germany.

Photo G. A power-block module allows 12 VDC to be sent to the downconverter via the coax.

Antennas

By far the best Mode "S" antenna buy for the money is the SB-32DXC from Bob Myers Communications. This custom-tuned version of an MDS-TV antenna installs easily and provides plenty of gain for reception of A-O-13 Mode "S" signals. It is a horizontally polarized, three-foot by two-foot, parabolically shaped reflector with feed assembly and RG-8 coax pigtail terminated with a male N-connector. The new version fits 1.5" to 2" booms and sells for $55.95 plus $12 UPS ground shipping in the U.S. Bob Myers Communications also carries some M-Squared antennas and can be contacted at the address noted above.

Other antennas worthy of consideration include loop yagis from Directive Systems (Dave Olean K1WHS) at RR1, Box 282, Lebanon, ME 04027, phone (207) 658-7758, and standard yagis from M-Squared via SSB Electronics in Pennsylvania, or direct at M-Squared, 7560 N. Del Mar Ave., Fresno, CA 93711, phone (209) 432-8873 or FAX (209) 432-3059.

Before Buying!

It is not possible to cover all the details of Mode "S" operation in a single article. Before joining the microwave satellite crowd, get the catalogs and flyers from the available manufacturers and providers, and study the subject in depth.

Early this year, AMSAT, the Radio Amateur Satellite Corporation, published *Mode S—The Book* by Ed Krome KA9LNV. Ed covers the history of 2.4-GHz satellite operation and provides all of the pertinent articles and information available on the topic in a concise, 8.5" by 11", 115-page paperback volume. In addition to discussion of practical construction techniques, the reader will find useful information on how to get started with 13 cm signals from A-O-13, PACSAT-OSCAR-16, DOVE-OSCAR-17 and the future Phase 3D "S"-mode transponder. Ed is a mechanical engineer, not a microwave physicist. His practical and direct approach to the topic is appropriate for those looking for "hands-on" input. This is must reading for the longtime satellite chaser and newcomer alike. The cost is $15.00 from AMSAT, 850 Sligo Ave. #600, Silver Spring, MD 20910. AMSAT's phone number is (301) 589-6062. Mode "S" promises to be the mode of choice for the next decade. Give it a try. You'll like it up there.

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

The Small Wonder Labs 40-30 Kit

The original NN1G rig by Dave Benson generated a lot of interest among QRPers. It's hard to follow up with a project that performs better than the original, but Dave has another hit on his hands. This rig originally started out as a club project for the New England QRP club, and was so popular among the members, that a second kit run had to be produced.

Dave's taken up where the original kit ended and made some slight modifications to the circuit. But, before we get to those, let's take a look inside the Small Wonder Labs 40-30 rig!

Having built more than enough QRP transceivers on 40 meters, I decided on a change to the 30 meter band. This band is full of active QRPers yet provides good DX possibilities. Best of all, you don't need to put up with the constant QRM from the broadcast stations, and there's no SSB to contend with, either. By gentlemen's agreement, digital modes such as AMTOR, packet, and RTTY are on the high end of the band, while CW occupies the lower end.

The 40-30 is simple in its design. With a 13.5-volt power supply, the rig will produce about 1.5 watts into a 50-ohm load. My unit did a hair more than 1.3 watts at 13.8 volts. Power produced at 12.5 volts was a solid one watt. That's more than enough kick to work all over the world on 30 meters. The 40-30 supports full break-in electronic keying with sidetone. Yet this rig does have a few drawbacks. First, there's no AGC. You control the audio gain by adjusting the RF gain control. The 40-30 won't drive a speaker. It's a headphone-only rig. There's no RIT, although you can add RIT by using an additional circuit board. I'll talk more about the RIT in next month's column. For now, we'll deal with the 40-30 in its basic form.

Signal Flow

RF from the antenna is controlled by a brute-force RF gain control. From here, the signals are passed through a single tuned circuit. An NE602 is used as a mixer by combining the VFO energy and the desired signals. The output is sent through a very simple two-pole crystal filter. Why only use two crystals? With a circuit such as this, most of us will never be able to tell the difference between two and four poles of filtering. It also reduces loss of signal through the filter, and it's cheaper, too. Even with a two-pole crystal filter, the selectivity is quite remarkable. The center frequency of the filter is about 850 Hz.

If you look at the schematic, you'll see something missing. The 40-30 lacks both IF tuned circuits and an IF amplifier stage. The output of the crystal filter is dumped directly into the product detector. You can move the product detector's frequency a bit to provide the proper offset in the receiver.

From the product detector, the output is coupled to a simple MOSFET switch and then on to the audio amplifier. As I mentioned before, the audio stage will not produce enough output to drive a speaker. The stage is robust enough that strong signals will automatically cause your fingers to move toward that gain control. As Dave mentioned in the assembly instructions, if you use a cheap pair of headphones, you'll get lackluster results. Those walk-thing headphones you see hanging up at the checkout counter for $2 will give you two bucks worth of sound quality.

VFO Circuitry

In the 40-30, instead of the usual variable capacitor controlling the VFO, a varactor is used. Tuning the VFO is accomplished by varying a 100k front-mounted pot. The tuning range is set by a small trimmer capacitor and by compressing or expanding the turns on a toroid core. This is the same method used by the NorCal 40 and has proved very popular with operators. By using the varactor diode, the builder has one less worry when assembling the kit. Mounting a variable capacitor to a panel can be a real engineering feat.

Building the 40-30

You should have gone through several soldering iron tips before tackling the 40-30. Although the circuit is very basic, there's not much room on the PC board. The circuit board is single-sided with a top silk-screen. All pads and traces have be solder-reflowed, and there is even a solder mask on the bottom.

All the parts are first rate, with several of the smaller diodes marked individually for easy identification. All the capacitors fit the board without tugging and pulling at their leads. Sockets are included for all ICs, even the NE602s.

Depending on the band chosen, the frequency-selective parts are packaged separately. Follow the directions closely, as you must not mix the contents of these envelopes with the rest of the parts.

You must wind your own coils. The Instructions for doing this are as clear as humanly possible. In fact, I'm impressed with the idea of using a hunk of paired hookup wire for winding the secondary on one of the phased transformers. It's about as fool-proof as you can make it. Even Scott should be able to figure this one out. It should be no big deal to wind the coils for this rig.

Setup and Adjustment

There are only a few steps required to get the rig on the air. First, you'll need a signal source. I used my Argonaut II running milliwatts into a dummy load. You'll also need a wattmeter for peaking the transmitter. Although not in the list of needed equipment, a frequency counter is really nice to have. If you don't have one and can't borrow one, then you can use a general coverage receiver to find the operating frequency of the VFO.

Alignment is straightforward. First, you need to find the frequency of the VFO with a frequency counter or your general coverage receiver. You then tweak the turns on the VFO toroid to adjust the frequency. A trimmer capacitor sets the band edges, while adjusting the coil gives you bandwidth.

Once the VFO is running at the desired frequency, connect your antenna, and, providing the band is up, resonate the front end by tweaking a second trimmer capacitor. At this point, you should be able to hear stations. Peak the stage for maximum audio by listening to a weak station. This completes the tune-up for the receiver.

Transmitter tune-up is just about as easy. Into a dummy load, key the rig and adjust the two trimmers for an indication of output using an RF power meter. I adjusted the transmitter by using my scope and peaking for maximum power while maintaining a clean sine wave. You can also press your station receiver into use by using it as a monitor peaking the transmitter for maximum S-meter. Back off the trimmer that sets the output power until the level drops, then turn the trimmer up until no more power is observed. Don't advance the power control past this point. The final adjustment to the transmitter is setting the TX offset. Again, you can use your general coverage receiver or make a quick job out of it with a counter.

Odds and Ends

I wound the VFO tank coil with the required amount of wire, but the final frequency was way too low. I removed a turn or two too many and ended up too high in the band. I added an extra 68-pF capacitor across the trimmer cap and then compressed the windings as much as I could to bring the VFO to the proper frequency. I'm sure you'll have to experiment with the VFO coil to get the proper frequency range.

The assembly manual mentions the polystyrene capacitors used in the VFO as being rather fragile. They are. After they have been soldered in, a glob of coil dope or some other goop is necessary to prevent them from moving about. I mention this not only to improve your frequency stability, but to keep you from breaking the leads off.

The final output transistor in the transmitter does not come with a heat sink of any kind. Dave assures me none is needed. During tune up, the stinker can get rather hot. I placed a TO-5 slip-on heat sink on the device just to make me feel better. You should do the same.

Dave put a lot of work into the assembly manual. It's not a step-by-step building guide, but it covers all the bases. If you have put several kits together, and know one end of a diode from another, you should have no trouble with this "small wonder."

Next month, we'll take a look at the RIT circuit and some other modifications to this rig.

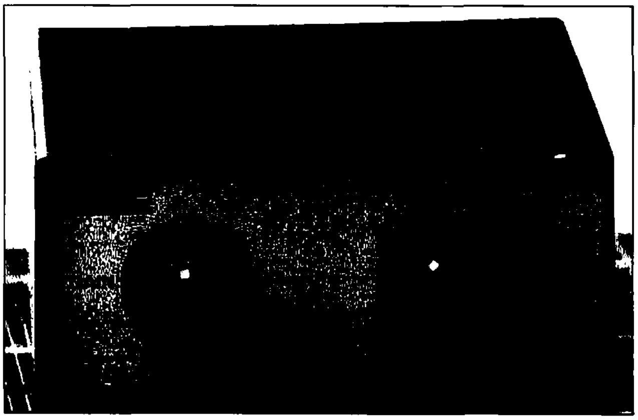


Photo A. The Small Wonder 30 meter rig sitting atop a small 10-watt solar panel.

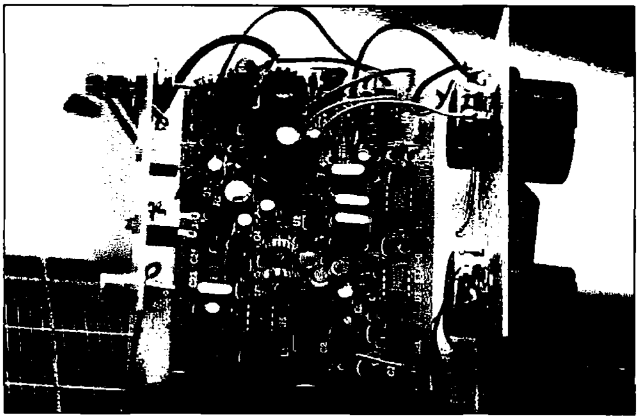


Photo B. Inside the rig. Everything mounts on a single board.

PACKET & COMPUTERS

Number 24 on your Feedback card

Jeffrey Sloman N1EWO
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Introduction to Packet Radio

While this subject may seem a bit simple to my regular readers, it seems like a good time to write an introductory column again. You may be surprised and learn something you didn't know. In any case, it will be a great column to pass on to these friends who want to get started in packet radio.

Just What Is Packet Radio Anyway?

Packet radio is one of the many "digital" modes available to radio amateurs. It is used on bands from HF to SHF, and is unquestionably the most popular way to send text and graphical information using amateur radio. With all of the other digital modes to choose from, what makes packet so popular?

Packet gets its name from the way that data is transmitted, in data "packets." By using this idea (called "packet switching"), packet radio's "protocol" (set of rules), called AX.25, can offer some big advantages over the other modes. The one that launched packet's popularity is "error detection and correction." Packet radio's AX.25 protocol offers error-free transmission. When a packet of data (technically referred to as a "frame") is sent from one station to another, it includes a "checksum." This checksum (it is a CRC—Cyclic Redundancy Check—for you math weenies out there) is the result of a mathematical operation performed on all the data in the packet.

When the packet is received at the intended destination, the receiving station performs the same mathematical operation. If the results do not match, it indicates that an error has occurred in transmission and the sending station is notified to resend that particular packet by its sequence number.

This system of error detection (checksum) and correction (resending) offers error free transmission—eventually. Sometimes it can take many tries before getting a "clean" packet. There are some things that can help with this, and we'll talk about them a little later.

What Do I Need to Get on the Air?

Thanks to the folks at TAPR (Tucson Amateur Packet Radio), who designed the original and updated hardware (TNC, or Terminal Node Controller) that made packet radio the popular mode it is today, getting on the air is simple. Exactly what to buy depends on two things: what you already own, and how much money you have to spend.

You'll need three basic components in any case: terminal, TNC, and radio system. The TNC is the heart of the packet station. It is the interface between the terminal (we'll discuss that in a moment) and the radio. Inside the box are two parts—the PAD (Packet Assembler/Disassembler) and the modem.

In packet radio work, we *don't* actually transmit digital signals over the air. Instead, we convert the digital information to sound and send that. This is the job of the modem, which gets its name from MOdulate/DEModulate. It is another version of what you use on the phone line to connect to BBSs and the Internet.

The task of the PAD is to take the information that we want to send and "assemble" it into packets. It maintains the connection with remote station (called a "virtual channel") and sends the data in packets that are understood on the other end. The reverse process happens there: The signals are demodulated in the modem and "disassembled" by the PAD.

This virtual circuit idea is pretty important, and it is where the idea of packet switching comes in. One of the other advantages of packet over other modes is that a channel can be shared. When two packet stations connect, a virtual channel is formed. The "owner" of the real channel (the frequency of operation) "switches" with each packet sent. There we get "packet switching." Other than having to wait around for its turn, your station thinks it is on its own channel.

The TNC you buy will depend on what you intend to do. Most packet today—almost all—runs at 1,200 baud. This used to be pretty fast, back when telephone modems were mostly 300 baud. Today we think nothing of 28.8 Kb/s phone modems, and some of us have access to faster connections. Nevertheless, packet radio does the overwhelming bulk of its end-user business at 1,200 baud.

If your intention is simply to get involved in PBBS (Packet BBS) use, and keyboard to keyboard operations (QSOs between individual stations), 1,200 baud will be all you need. Today, prices for TNCs range from around $100.00 for a simple unit that does the basics, to several hundred for a DSP (Digital Signal Processing) unit that is really more than a simple TNC and is referred to as a multimode controller.

In the first category, products from AEA, MFJ, Kantronics, and PacComm all offer good performance for the average user. One of the more popular "beginner" units is the KPC-4 from Kantronics; its small size and low power requirements make it a good portable option as well.

For a multimode box the selections are more complex. If you'd like to get into the HF modes (RTTY, AMTOR, PACTOR, and other relatively esoteric things), you'll need to choose carefully. For the average HF/VHF packet user, the PK-232 from AEA is a reliable winner. Its excellent filtering makes HF work easier, and its design is well proven. The DSP-2232 from AEA represents the high end, with DSP-based, dual-port operations. Your wallet will notice the increased capabilities.

Another real option, of course, is the hamfest. If you look around for TNCs at a hamfest, make sure you get a TNC-2 model; this is very important because a TNC-1 may be able to have its firmware updated, but it will be a hassle. Look for products from the companies mentioned above, and you can probably walk away with a good unit for fifty bucks or less.

> ***"So if you want to get started in packet, look around at what you have (radios and computers), look around at what to buy (TNCs or multimode controllers), and make a careful selection."***

The Terminal

Technically, all you need for this function is a "dumb terminal." One of the old-fashioned "glass teletypes" would work fine; *but*, today there is so much software available doing such nice things that you really *want* a computer. The overwhelming majority of hams use IBM-PC machines. Just how capable the machine needs to be depends upon how you use it. Most of the DOS-based packet software runs well on a 1-MB 80286 machine. You don't even need a hard drive in most cases. On the other hand, if you'd like to run the latest and greatest of packet software, you'll need a machine that can run Microsoft Windows. The best bet is to talk to *lots* of ham friends, see what they are using, *use it yourself*, and then decide.

The Radio System

I refer to radio "system" because I include the antenna. There is a great temptation to take that old handheld, blow off the dust, and stick it on packet. This is likely to be a problem. It is not that it won't work, since it will transmit and receive fine. The problem is that you may not be able to communicate with anyone.

OK, now you are confused. If the radio works fine, I can hear the station I am trying to talk to, and it can hear me—why can't we communicate? Anyone who has experienced this phenomenon knows just how frustrating it is, and wants it to stop! The problem is called "hidden transmitter syndrome" and here's how it happens ...

At the lowest level, packet radio networking is based on the idea of CSMA/CD (Carrier Sense Multiple Access/Collision Detection). This is the name of the method of sharing the channel. The mechanics will be very familiar to any active ham—you use this technique every day. "Carrier Sense" means to listen to the channel and see if anyone else is keyed up. If there is someone on, say, the repeater, you are careful not to key up over them. "Multiple Access" simply refers to the fact that more than two stations can use the same frequency. This is opposed to point-to-point linking, in which two stations exclusively use a particular frequency. "Collision Detection" means that the protocol can say,"hey, you guys doubled," when two transmitters happen to key up at the same time.

It is the CS portion of this access method in which handhelds (with weak transmitters and often poor receivers) cannot properly participate. A hidden transmitter is a station that cannot be heard by *everyone* trying to use the frequency. This means that those who cannot hear will try using the channel *on top of the hidden transmitter.* A poor receiver causes everyone to be a hidden transmitter.

Because of this, beware of handhelds. Use a good *omnidirectional* antenna, and put an amplifier with a preamp on that handheld if you must use it. If everyone on the frequency participates properly in the LAN (Local Area Network), everyone benefits. *Remember, this is true even for keyboard-to-keyboard QSOs!*

So if you want to get started in packet, look around at what you have (radios and computers), look around at what to buy (TNCs or multimode controllers), and make a careful selection. Don't try to use something inadequate, because you'll just get frustrated and quit. Do it right, and have fun. 73 de N1EWO.

HOMING IN

Number 25 on your Feedback card

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92633

APRS Puts Doppler Bearings on the Map

"It's like a moving finger that keeps pointing toward the signal." That's the way one ham describes his Doppler radio direction finding (RDF) set. Typical of most Dopplers, his has a circle of 16 light-emitting diodes (LEDs). At any instant, one LED is on, indicating the direction of the incoming signal.

Dopplers work with all types of narrowband FM receivers, including scanners and handhelds. Some include a digital display in degrees, in addition to the LED ring. Doppler antennas, which have from 4 to 16 vertical elements, are available for home use and for easy mounting on a vehicle. (See the resource box.)

You might think that hunting signals with a Doppler RDF set is as easy as fishing in an aquarium. Just follow the LEDs, right? Occasionally it's that simple, but more often the Doppler display is tricky to interpret. Incoming signals are reflected and scattered by buildings and terrain features near you and near the transmitter. This multipath, as it is called, makes the Doppler think there are several signal sources instead of just one. So, depending on the multipath where you're RDFing, sometimes you will see one steadily lit LED, and at other times the indication may flutter, wander back and forth, or even dash around the circle.

Then there is the matter of knowing exactly which way and how far to go to find signal sources. The Doppler's direction indication is relative to orientation of the antenna set. In a fixed installation, this is the same as a bearing with respect to north. In a mobile, you must know your car's heading accurately to be able to compute the compass direction of the signal from the Doppler indication.

A Doppler gives you only direction data, not distance. As you drive toward the transmitter, your S-meter will probably be pinned by the time you are within a few miles. Unless you go to the trouble of using an RF attenuator, you will have few clues about how close you are getting until there is a sudden change of bearing that tells you that you passed it!

Wouldn't it be great if your Doppler indications could be displayed directly on a road map? While we're at it, why not have bearings from other base and mobile stations appear on the same map, so you can see instantly where they intersect? Automatic Packet Reporting System (APRS), a shareware computer program, makes all this possible right now.

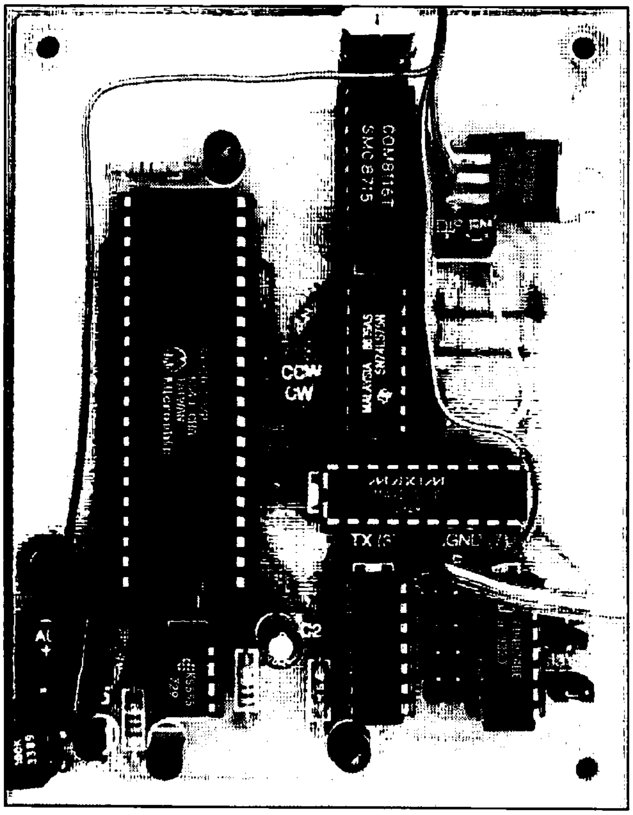


Photo A. N7LUE's Version 1 interface board measures 3-1/8 x 4-1/8 inches. I added a 7805 regulator at the +5V input terminals on mine. A 9-wire ribbon cable connects to my Roanoke Doppler via DB-15 connectors to pick off power, audio, and parallel data.

Retire Your Protractor

When Bob Bruninga WB4APR first developed APRS, it was just for mapping packet stations, both fixed and moving, for fun and public service. He envisioned it as a way for officials at events such as marathons and boat regattas to instantly spot the locations of contestants, VIPs, ambulances, and so on. Then he began to add features such as dead reckoning of moving objects, messaging between unconnected stations, and grid-square plotting.

With the latest version, storm tracking nets can pinpoint their weather spotting units, HF contesters can display Packet Cluster DX reports, and transmitter hunters can create multistation RDF networks to quickly zero in on jammers, stuck transmitters, and stations in distress. WB4APR's program runs under DOS (not Windows) and can be used in just about any PC, from a 6086 laptop with CGA in a mobile to a high-end hamshack desktop in full color.

Macintosh fans have not been left out. Keith Sproul WU2Z has coded up a work-alike program. It runs best on Mac-II class machines with System 7, but will also work on older 68000 Macs. MacAPRS follows all the PC-APRS packet protocols but takes full advantage of the Mac's capabilities for higher resolution maps, pull-down menus, multiple windows, and the mouse. A MacAPRS native version for PowerPCs is also available.

Since APRS PC version 3.0 was released last year, the program has included a steadily improving suite of RDF features. The most advanced of these are the Doppler inputs, which became fully operational in version 5.03a. Bob added routines to accept and display bearings from Doppler Systems RDF models having 300-bps RS-232 output. For Doppler Systems models without serial data output, and for other brands of Dopplers, WB4APR collaborated with Robert Swain N7LUE to develop a universal interface.

The project was so successful that N7LUE is now selling boards, kits, and complete interfaces (Photo A). "I'm trying to make it as close to a Heathkit as practical," Robert says. "This is my first experience in writing kit-building instructions, but I've had lots of experience in the military telling people how to put things together."

Inside the Interface

In all of the popular Doppler designs in the ham market, the 360-degree azimuth circle is represented by 8, 16, or 32 LEDs. Somewhere in the control/display electronics, 4-bit parallel data representing antenna position and a direction pulse to latch this data for the display are available. Figure 1 shows how N7LUE's interface converts this parallel data to a serial output. All signals are tapped from the Doppler circuits; normal operation of its LED display is unaffected.

U1 is a 74HC75 4-bit latch. It is disabled when the circuit is used with Doppler Systems, Dick Smith, and other designs that have latched 4-bit direction data available. Other Dopplers such as the 16-LED KØOV/WB6UZZ Roanoke Doppler and the WA4BVY DoppleScAnt use a 4514 or 4515 latching 4-to-16 decoder IC, which does not put latched 4-bit direction data onto external pins. Data is latched by U1 for these models.

Latched data from U1 goes to U2, a Microchip AY31015D universal synchronous receiver/transmitter (UART) that performs the parallel-to-serial conversion. The output of U2 is a stream of 8-bit ASCII characters from

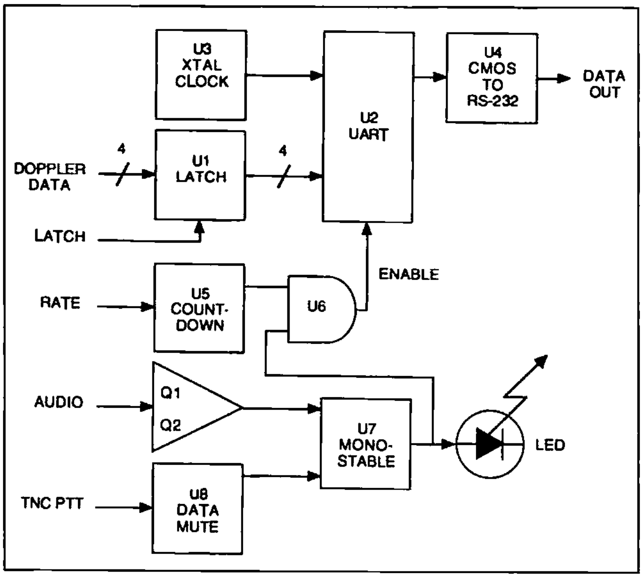


Figure 1. Block diagram of N7LUE's universal Doppler-to-RS-232 interface for RDF with APRS.

"@" (01000000) to "O" (01001111), representing the 16 possible states of the 4-bit input data. U2 is programmed for 2,400-bps 8-N-1 output, as expected by APRS.

Note that no matter how many LEDs or vertical antennas your Doppler has, N7LUE's board always outputs 16 output characters, representing 22.5-degree azimuth increments. U4 converts the serial data from 5-volt logic level to RS-232 standards.

APRS software can process about eight bearing samples per second. U5 is a 4024 binary countdown, driven by the Doppler's antenna rotation clock oscillator. Its 8-Hz output sets the UART character output rate. Q1, Q2, and U7 sense receiver audio, preventing random data output when no signal is being received.

U8 was added to the design for situations where APRS is transmitting packet bearings in the same band that the Doppler is monitoring. When the packet TNC is keyed down, the Doppler bearing will probably be erroneous. The U8 data mute interrupts serial output during packet transmissions, to prevent these bad bearings from being processed by APRS.

Crunching the Bearings

WB4APR's software accumulates and calculates the average and standard deviation of a series of bearing samples to the nearest degree. It plots the average as a yellow vector on the screen map. The standard deviation calculation gives a measure of the quality of the bearing data. When samples differ greatly in direction over a short time, deviation is large and the displayed line is dotted to indicate a low quality bearing. The more breaks in the line, the larger the deviation is. When Doppler indications are steady, deviation is low and the yellow line is solid. A violet rectangle at the top of the APRS map display provides additional bearing quality data.

Photo B shows typical APRS Doppler data displayed on a base station PC screen. The dashed yellow bearing lines from the KØOV icon were picked up during a 30-second transmission from a mobile station. The cross-bearing from WB6UZZ/M could have been received and plott..d by packet or entered manually by the APRS operator from a radio report.

The APRS cursor has been moved manually to the intersection of the KØOV and WB6UZZ bearings. The exact latitude and longitude of this intersection is displayed in a box at the upper left corner of the screen. If the bearings are good, that is where the transmitter is. Even if the APRS map has errors in the location of roads and towns, the coordinates obtained by triangulation are correct if the coordinates of the RDF stations have been correctly entered.

Now that the APRS base station has coordinates for the unknown signal, its operator can notify mobile transmitter hunters. Better yet, the base station can automatically transmit a stream of packet transmissions with bearing data to a group of mobile transmitter hunters running APRS and their own Dopplers. The mobiles must input their locations and vehicle headings to APRS for bearings to be plotted. Although this can be done manually, the best way is with the NMEA-0183 output of a Global Positioning System (GPS) receiver.

Since most laptop PCs have only one or two serial ports, hooking up three peripherals (TNC, GPS and Doppler) poses a major roadblock. WB4APR has created a Hardware Single Port (HSP) mode to permit GPS and TNC to share one port. You will need to build a two-transistor data switch, activated by the Data Terminal Ready (DTR) line on the serial port. Details and circuits are in the README.GPS file in APRS documentation.

To work with the serial RDF interface, your copy of PC-APRS must be registered with a DF validation, which costs an extra nine dollars over the regular APRS registration fee. However, there are other ways to get RDF information into the APRS screen without special registration. Any base or mobile station running APRS can manually put its RDF bearing into its station position report to be transmitted on packet. An APRS operator can also get RDF bearings and positions of other base and mobile stations via voice radio, then enter and transmit them on packet from his station.

Packet stations not running APRS can put their RDF bearings in their beacon texts. If formatted properly, APRS-equipped stations receiving the beacons will automatically receive and display the bearing lines. The APRS README.DF file gives detailed explanations of how to do all this.

The README.DF file also describes how to set up remote, unattended RDF stations consisting of a receiver, Doppler, serial interface, and packet TNC. No computer is needed if the TNC is set up to properly format and beacon the RDF data. Three of these stations at good receiving sites around a city could give any APRS station in the area instant triangulation data whenever an unknown signal comes on the air.

WU2Z has provided excellent RDF features in MacAPRS, such as mouse-drawn bearings with range and exact coordinates indicated in a data box. However, the Doppler inputs are just partially implemented as of this writing and I have not had an opportunity to try them on my Mac as yet. Keith says that MacAPRS bearing quality is indicated by line color, not "dottedness" as with the PC version. He has not incorporated the HSP mode, but is looking for ways to do it, perhaps by the time you read this. The basic MacAPRS registration includes serial Doppler data input.

Get in on the Ground Floor

APRS and its interface to Dopplers and GPS are not a "plug and play" system yet. The hardware and software are constantly evolving in response to user feedback. Every ham's APRS installation will have unique challenges due to differences in computers, Dopplers, TNCs, and GPS receivers. There are important control and local QRM issues involved in setting up remote RDF sites. Your experiences and suggestions are needed to optimize the bearing averaging algorithms.

There is no way that "Homing In" can cover all the nuances of setting up APRS RDF networking. You will need to read the voluminous APRS documentation and plan your installation carefully. This effort will pay off in your being the "first on your block" to use a revolutionary RDF technique that may someday become a commonplace way for hams to perform public service and self-policing.

Both APRS authors welcome your questions and constructive suggestions. E-mail is the best way to communicate with them. If you write, enclose a self-addressed stamped envelope for the reply. Allow some time for a response, as they are very busy hams. Let me know your RDF ideas and experiences, too. Write to me at the address at the beginning of this article or send E-mail to me via Internet [HomingIn@aol.com] or CompuServe [75236,2165].

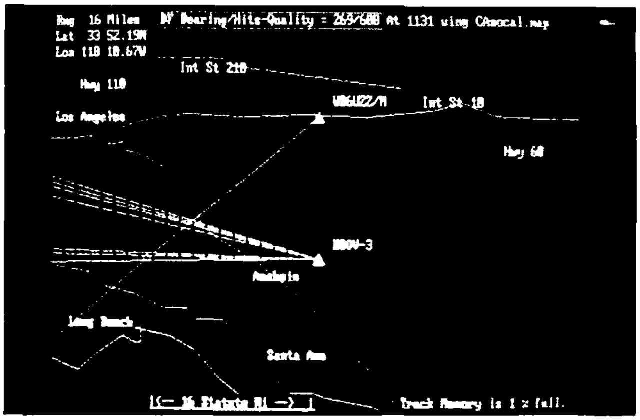


Photo B. A typical APRS base station RDF display on a color PC. A southern California APRS map with more detail is available, but a rudimentary map is shown here to make the bearings stand out clearly.

Resources for RDF with APRS

Hardware for the Doppler-to-RS-232 interface is available from Robert Swain N7LUE, 360 Phirne Road, Glen Burnie, MD 21061 [CMPK59D@prodigy.com]. Bare boards are $15 each, board-and-parts kits are $49, and an assembled/tested interface is $69. Add $3.00 for shipping. State your model of Doppler unit when ordering. Prices are for Version 1 boards without data mute circuit; future boards/kits with this feature may be slightly higher. Kits include sockets for all ICs. Due to wide variations among computers, an RS-232 connector is not provided. Power requirements are +5 VDC at 85 mA.

Complete plans for the inexpensive Roanoke Doppler RDF set are in *Transmitter Hunting—Radio Direction Finding Simplified* by Joe Moell KØOV and Tom Curlee WB6UZZ. This 323-page reference (TAB Books #2701) covers all aspects of RDF and is available from Uncle Wayne's Bookshelf. Antenna system improvements are in "Homing In" for April and June 1995.

Bare circuit boards for the Roanoke Doppler control/display circuits are available from Tom Lewis AB5CK, 6721 Rolling Hills Drive, North Richland Hills, TX 76180 [tlewis@dfw.net]; and from Marty Mitchell N6ZAV, 340 Otero, Newport Beach, CA 92660 [n6zav@netcom.com].

A line of wired/tested Doppler RDF displays and antennas for bands from 108 to 1,000 MHz is sold by Doppler Systems, Incorporated, PO Box 2780, Carefree, AZ 85377; (602) 488-9755. Some models include RS-232 data output in ASCII format; the N7LUE board is not required for APRS interface with them.

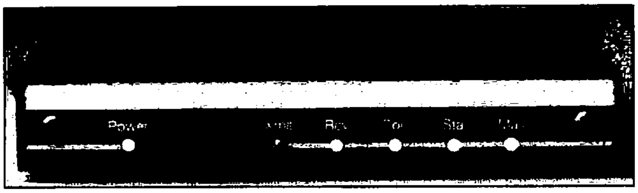
For detailed descriptions of PC and Mac versions of APRS and their use with GPS receivers, see "Homing In" for October 1994, January 1995, and February 1995. The programs are available via modem from many online services and on disk from the authors for a nominal fee. New versions are posted first on the primary sites.

An Internet message reflector (mailing list) is maintained by TAPR for APRS experimenters. Subscribe by sending a one-line message to listserv@tapr.org with the text "subscribe aprssig <your E-mail address>" and nothing on the subject line.

As of this writing, the latest version of APRS for PCs is 6.9. Primary site is the Annapolis BBS at (410) 280-2503. Registration fee is $24 plus $9 each for optional GPS and Doppler serial inputs. Disk fee is $9. Author is Bob Bruninga WB4APR, 115 Old Farm Court, Glen Burnie, MD 21060 [E-mail via the TAPR aprssig].

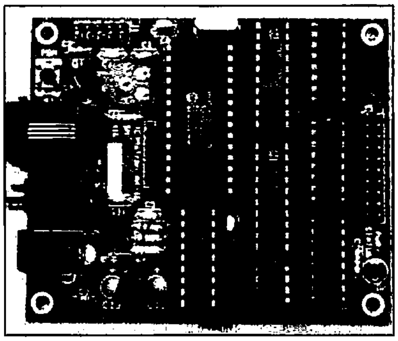
As of this writing, the latest version of APRS for Macintosh is 1.5.5. Primary site is ftp.tapr.org directory /tapr/sigs/aprs. Registration fee is $30; disk fee is $10 (high density). Author is Keith Sproul WU2Z, 698 Magnolia Road, North Brunswick, NJ 08902 [ksproul@noc.rutgers.edu].

NEW PRODUCTS



KANTRONICS

Kantronics has announced the release of Version 6.0 of its KPC-3, which offers some of the most powerful GPS (Global Positioning System) capabilities available in a TNC. To receive and re-transmit GPS data, the KPC-3 connects to GPS receivers with NMEA-0183 interfaces. Its user-friendly GPS capabilities are highly advanced for maximum performance and flexibility; users select as many as four of the GPS unit's NMEA data strings; GPS data can be stored for later retrieval and is accessible via the KPC-3's mailbox; users specify beacon start time and amount of time between beacons, so that multiple stations report without collision; the system operator can reconfigure the GPS unit from a remote location; and it's APRS compatible. Also, Kantronics has a low-cost EPROM upgrade available for earlier versions. For the price and more information, contact *Kantronics, 1202 E. 23rd St., Lawrence, KS 66046; (913) 842-7745, FAX (913) 842-2031.* Or circle Reader Service No. 201.



MOTRON ELECTRONICS

The Auto-Kall AK-16 is the newest member of the MoTron Auto-Kall product line. It is a DTMF controller with 16 relay driver outputs, DTMF to X-10 home control, CWID, and Morse response tones. A relay board with screw terminal blocks, sold separately, can directly mate to the AK-16 for easy set-up.

All 256 X-10 house/unit codes can be addressed, letting you control lights, appliances, gates, etc., with the DTMF keypad on a handheld or mobile radio. You can also configure outputs for several different modes of operation. One mode makes it possible to control easily the pan/tilt focus/zoom functions of a remote video camera and also provides latching outputs for controlling transmitters, lights, etc. The AK-16 can be configured with a Morse response after each output is turned on or off, or triggered momentarily, assuring you that the command was received and executed. You can also program the 0- to 12-digit security code and 32-character CW ID using a DTMF keypad. The AK-16 furthermore has a serial output that converts incoming DTMF to ASCII for input into your computer.

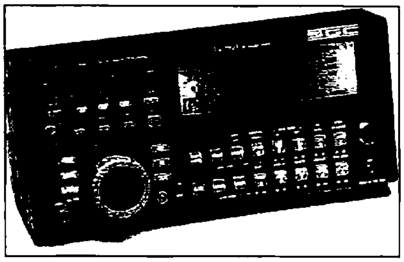
The AK-16 is sold as a fully assembled circuit board. The price is $99 and is available from *MoTron Electronics at (800) 338-9058, FAX (503) 687-2492.* Or circle Reader Service No. 206.

SGC, INC.

SGC, Inc. has introduced the PowerTalk ADSP-SNS Control Head for the SG-2000 or SG-2000SP transceiver. PowerTalk incorporates adaptive digital signal processing and spectral noise subtraction to provide unsurpassed signal quality on the HF bands, with user-friendly operation via LED indicators.

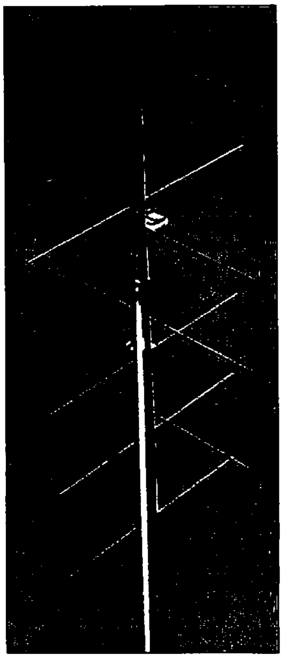
The PowerTalk ADSP reduces unwanted noise. In addition, the operator can adjust the frequency range by means of Upper and and Lower Corner frequency controls, and can then adjust the center frequency up or down via the spinner knob control, resulting in clear signal quality. The SNS feature subtracts noise in the spectrum where voice modulation is not present, further enhancing the signal. A notch filter feature allows up to live tones to be suppressed simultaneously, and user memory (eight preset and seven user programmable) allows the operator to configure the frequency and mode he wants for ease of operation. Surface mount technology ensure reliability in any environment.

The PowerTalk control head is designed to operate with the SG-2000 or SG-000SP transceiver. The SG-200 series of SSB rediotelephones are 150 watts and 644 channels and operate in the 1.6 to 30 MHz range.



The introductory price for the SG-2000 PowerTalk is $2,495. For additional information or to receive a brochure on this new product, contact *SGC, Inc., P.O. Box 3526, Bellevue, WA 98009; (800) 259-7331, FAX (206)-746-6384.* Or circle Reader Service No. 208.

WOODHOUSE COMMUNICATION

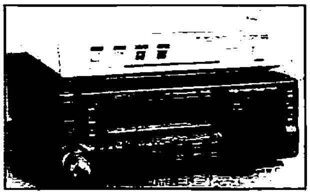


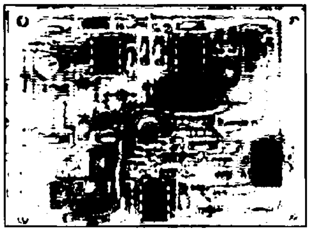
Woodhouse Communication has introduced a new line of specialty VHF antennas. Amateur band antennas for 144, 220, and 440 MHz offer extremely heavy-duty construction using 1" OD, thick wall booms, and solid 3/8" rod elements. All components are 6061-T6 aluminum, with 100% stainless steel hardware. A unique matching transformer and conservative antenna design provide full band coverage with low SWR and good pattern response. Various models offer replaceable baluns, and the ability to upgrade at a later time. All models feature rear mount with supplied brackets.

For polar orbital weather satellite reception, the APT-4X4 is specifically designed for 137 MHz circular polarized use. The same heavy-duty construction is used in this-one-of-a-kind antenna for NOAA and MET APT imaging. Selective frequency operation and good gain figures provide clean, noise-free images on passes as low as 9° maximum elevation providing a total east/west viewing range of up to 4,000 miles.

Custom antennas for other services are also available. For Information or product guide, contact *Woodhouse Communication, P.O. Box 73, Plainview, MI 49080-0073; (616) 226-8873, FAX (616) 226-9073.* Or circle Reader Service No. 203.

COMMUNICATIONS EQUIPMENT COMPANY





From Australia comes the CEC model SP-500 RF Speech Processor Plus, designed to help achieve maximum performance from SSB radio equipment. It can provide an 8-dB increase in a signal's readability under weak and noisy reception conditions, having the same effect as more than quadrupling your transmitter output power. The SP-500 incorporates such features as multimode "E/K" End of Transmission Beep (ETB) generator, LED bargraph level indicator or bypass switching to allow for "with" and "without" comparison tests. The SP-500 RF is priced at US$210 plus freight from Australia.

Using circuitry similar to the SP-500, the little SP-100 RF also packs as much punch. Both units bring the amplitude of the low-level component up close to that of the peaks, thereby decreasing the average-to-peak power ratio. Because they do this at RF, using their own internally generated SSB signal, they produce a much cleaner output waveform and more talk power than any audio processor or power amplifier microphone. With the SP-100, however, installation is simplified by the fact that it connects in series with the microphone's audio line. The SP-100 RF is priced at US$75 plus freight from Australia. For more information or to purchase either item, contact *GFS Electronics, P.O. Box 97, Mitcham, 3132, Victoria, Australia; 61-3-9873-3777 or FAX 61-3-9872-4550.* Or circle Reader Service No. 204.

NEVER SAY DIE

Continued from page 4

a navigator who can help the driver follow the route Instructions, which often are misleading, and keep exact track of the time and distance despite frequent speed changes in the instructions. You can see why a good watch and calculator are necessary. We get irritated with today's digital watches if they are off by a mere few seconds a month.

Not only did I Import the watches, but I also adjusted them for the needed accuracy.

When I moved from New York to New Hampshire, I left rallies behind. I've some great rally stories to tell, but I'll save them for my memoirs. As president of the Porsche Club of America,I put on rallies that the participants still talk about. Ask John Freels WBØFBK, if you run into him on the air.

Whatever I get interested in, I seem to find some way to be an entrepreneur.

Right now the cold fusion field needs information, so I'm gathering and selling it. When I was into computers I published magazines and books, started a couple of software companies, started a string of software stores, and so on. When I published music magazines I built my own recording studio, started several record labels, got into brokering CD manufacturing, and so on. I can't help it. Besides, it's all fun!

This All Started . . .

...a couple of months ago. I'd gotten word that the first patent had just recently been issued in the cold fusion field. Some inventor named Jim Patterson down in Sarasota, Florida, had pulled off this coup. This was all the more remarkable because someone high in government seems to have been putting the hex on cold fusion.

The Patent Office has had orders from someone not to issue any cold fusion patents, so there are hundreds of applications backed up. The Department of Energy (DOE) seems to have orders not to grant any research funds to any school or organization that is permitting any cold fusion experimenting to be done. This has caused terror throughout the universities that some undergraduate might run an experiment which could be construed as being cold fusion oriented and thus lose the university millions in research funds.

Indeed, I read in the Rensselaer newsletter that students there had successfully confirmed the Pons & Fleischmann claims of excess heat from palladium and deuterium. But my several letters requesting further information have remained unanswered, even though I have been a major contributor to the university, was their first Executive in Residence, and serve on the RPI Council and the Board of Overseers.

I called Jim Patterson to find out more about his patented cold fusion cell. It seems that he sneakily did not mention cold fusion in his patent application, but did show substantial excess heat in the data he presented. He'd already had patents issued for his process for manufacturing microspheres, and this was just an add-on to those earlier patents. Also, Jim being a very old person (my age), the Patent Office has a separate track for patents where the applicant could well die of old age waiting for them to act. So he promptly got his patent.

Jim mentioned that Dennis Cravens, a teacher from a small community college in Texas who has been doing cold fusion research in his garage with his own money, and as a result is one of the leading American researchers In the field, would be coming to Sarasota In a few days to confirm the excess heat generated by his cell. I went down to watch.

I used to live in Sarasota, where I worked as an engineer-announcer at WSPB. But that was 45 years ago, so I found things had changed. For instance, my old radio station is run by cartridges, with almost no staff needed.

Dennis had been delayed a week, so I had plenty of time to meet and talk with Jim. I sure wish he was a ham so we could talk without the telephone company making so much money. Jim Is a fascinating chap. What he'd done is take his polymer microspheres and give them a very thin coating of palladium, so that his cell had the greatest possible amount of palladium surface area per unit volume. The result was that, when he passed a current through it, the palladium metal lattice structure absorbed the hydrogen in minutes instead of days to weeks. Researchers have found that it's necessary to get around 85% of the palladium volume loaded with hydrogen before the excess heat action starts.

So here was a way to get excess heat generated in minutes! Jim had a setup running and I checked the instrumentation. Sure enough, it was putting out several times more energy than was being used to trigger the action. Dennis arrived a few days later and confirmed everything.

Since the fifth annual cold fusion conference (ICCF-5) was coming up in a few weeks, Jim and Dennis put together a working demo system in a clear plastic box and shipped it to Monaco for the conference. They set It up there and had it perking for the four days of the conference just outside the big meeting room. It was turning out a minimum of 300% more energy than going in, and towards afternoons up to 600%. And that didn't even count the heat lost to the air of the room from the cell, the heat from the escaping oxygen and hydrogen gasses, and the potential heat from recombining them.

If there were any skeptics about whether cold fusion works, this exhibit at the conference should shut them up. The instrumentation and readings were checked by scientists from 15 countries and the results confirmed. However, I'm put in mind of the little problem Galileo had. His fellow scientists refused to look through his telescope. Pasteur had the same problem when he tried to convince the scientists of his day that there were germs. He couldn't get them to look through his microscope. Today many scientists are so completely convinced that cold fusion is impossible that they won't even look at a working demonstration.

The Patterson patented cold fusion cell Is just the beginning. Lacking an accepted theory as to why the excess heat Is happening, researchers are working empirically. They need to test other metals, electrolytes, temperatures, pressures, voltages, RF excitation, and so on. Will this work better at 300° C than at room temperature? And so on.

Jim has improved his microspheres by first coating them with copper as a base, then nickel, a layer of palladium, and another layer of nickel. The nickel keeps the palladium from flaking off, and it loads with hydrogen almost as well as palladium. The minute amounts of palladium needed for the cells saves money over using palladium bars or sheets.

But here's an area of research that any inventor could get into for peanuts and have a good chance at coming up a big winner. Bill Gates saw his opportunity when the microcomputer industry was at about this level of development. He'd written a Basic interpreter for the 8008 chip as part of his lab work at Harvard. Then, when the MITS Altair 8800 computer was introduced and was in desperate need of software, Bill left college to work at MITS and the rest is history.

Steve Wozniak saw the need for a single-board computer instead of the old mother-board system with plug-in modules for everything. He cooked one up at home. Steve Jobs saw the potential and together they made hundreds of millions. Gates made billions. History is all set to repeat with the cold fusion field except that it is going to grow to a hundred times the size of the computer industry. It's going to shoot into the trillions.

I was there right from the first in the computer explosion, publishing magazines. I'm doing the same in the cold fusion field.

Monaco

Around 200 scientists gathered for the conference. I already knew most of them from the last conference on Maui, so it was fun getting together again to talk. Six members of my board of scientific advisors where there . . . from Belarus, France, China, India, Japan, and the US.

Yes, of course I got a 3A/W2NSD ticket so I could get on 2m with my HT. They do have repeaters in France and Italy that can be reached from there, but the conference kept me too busy to operate as much as I'd have liked. Papers were being presented all day long, and then in the evening I read through other papers, read a few relevant books I brought along, and even managed some writing with my laptop.

Most of the papers presented at the conference showed progress, but none were as eye-opening as the Patterson demonstration. And that was the only live act.

Sherry and I made the trip via London, stopping off for a day of rest, seeing two London shows, and getting together with Ray Howes G4OWY, who is both a *73* and a *"Cold Fusion"* reader. From there we took the Chunnel train to Paris. It topped out at 187 mph, whipping through the Chunnel In no time. It turns out there isn't much to see in a tunnel unless you are in Disneyland or Coney Island.

The trip to London was a long one. Sherry used the flier miles garnered by using our MasterCard so we could go first class. We charge every business expense we can to the card so we can fly for free on the flier miles. But the only seats available forced us to fly to Houston from Boston, and then on to London. That added about eight extra flying hours. Flying and feeding hours, actually. In first class, they keep the food coming. By the time we got to London we'd eaten our fill and had enough left over to carry us for a couple more days.

The next day, after getting to Paris, we took the high-speed TGV train to Nice, and then the local to Monaco. Monaco Is fine, except for two things. If you don't gamble there is almost nothing to do. But they made up for that with high prices. Would you believe $4 for a Haägen Dazs cone? A painful place for a known skinflint like me to visit.

We did take a bus tour where we visited a perfume factory with a huge sales room, and the scene of Princess Grace's fatal accident. And that was about it for Monaco. My bags were so stuffed and loaded with the most recent issue of my cold fusion magazine that I didn't have room to bring a low band ham rig and antennas. Nor the time to get on the air if I had.

The trip did give me an opportunity to finish Lerner's *The Big Bang Never Happened*, which I've mentioned before. It completely demolishes the Big Bang Theory of how the universe started. But even more Important, Lerner's explanation of how solar systems get started made sense. He shows the equations involved in the plasma-like action that forms them and then goes on to show that the exact same forces have formed the galaxies and then—going up another level of abstraction— the super galaxies.

The same equations also work for laboratory-sized plasmas, and are derived from fluid mechanics. This is the same source that Maxwell used in deriving his famous equations for magnetism and radio waves. But the thing that really hit me was the concept of the plasma, with its light vortex In the middle spinning down, then spreading out and back up to go down the vortex again. This was exactly the same drawing I'd seen in Phillip's *Direct Perception of Quarks!* This stemmed from the work of Besant and Leadbeater as published in 1895 when they meditated on the makeup of the atom. They were able to break it down Into what we today call subquarks and describe their action as we know it now. And it was exactly the same as that generating solar systems and galaxies!

Here might be the answer to cold fusion! The main problem has been how to get two protons to get together, and

that meant overcoming the Coulomb Barrier between them. Physicists have believed that the only way to do that is to get the atoms up to hundreds of millions of degrees so their energy would be enough to break the barrier. Thus the $10 billion or more so far invested in hot fusion research.

But suppose the energy generated in the plasma vortex is enough to break that barrier! That would allow fusion to take place on a micro-scale, giving us the heat we see.

This would also help explain why scientists have been seeing similar results from sonoluminescence and hydrosonic research. And it would tie in with the scientists preaching ball lightning and plasmoid action.

I've run my theory by several experts and have been encouraged to propose it in my magazine. The idea of a non-scientist like me solving a problem which has been baffling Nobel prize scientists is exciting, but I'm prepared for the bubble to be burst. It does make sense on a conceptual level, so we'll see. It helps tie a lot of loose ends together.

I'll tell you this, if I was maybe 10 years younger I'd be setting up my own lab and going after some patents. The field is wide open and there's almost no competition in America. It's the Japanese who are making the most progress, but then their government is supporting them. Now, I wonder who it is in our government who has put us so far behind, and who paid him to do it?

Pons & Fleischmann

They got so angry when they were humiliated by the media after several labs were unable to confirm their cold fusion reaction that when Toyota came along and offered to build them the lab of their dreams anywhere in the world, they left the country. They're now happily working in their $10 million lab on the French Riviera, not far from Nice.

A year ago, on a BBC documentary, Dr. Fleischmann showed a cell a little larger than a Thermos bottle. "How much power can you generate with that," he was asked. Dr. Fleischmann responded,"Oh, about 10,000 watts." The interviewer then said, "And how often will you have to refuel it?" The answer: "About every ten to the fifth years."

Pons and Fleischmann were completely silent about their progress at the Monaco conference. Indeed, they locked up their nearby lab so no visitors could see it for the duration of the conference. This bolsters my suspicion that Toyota will be coming out with a car in a few years with a sealed engine that will never require any fuel. Just think what that will do to the car market! It'll go 100% imported cars in short order.

A ham introduced himself at the conference. He said he was there from Wall Street, looking for potential investments. Well, even at this early date the sharks are circling. I watched one guy I personally know to be a real sleaze sneaking around, talking with scientists, urging them to do business with his company.

Oh well, this isn't really ham stuff, so you're probably not interested. Please forgive my enthusiasm and my pushing you to get involved with making money. It's just that money is so easy to make if you keep your eyes open and go with the tide instead of fighting it.

Disneyland — Paris

Since Sherry and I have done the Anaheim, Orlando, and Tokyo Disneylands, it seemed only reasonable to take a day on the way back home and see how the Paris Disneyland stacked up. We did not pick a good day. Easter Sunday was cold (40°), overcast, and windy. And the place was packed solid. We didn't even try to go on most of the rides. For instance, the train around the park had a one-hour waiting line. And then we found that it went behind most of the park areas so there was little to see on the ten-minute ride.

What surprised us the most was the food. The food at all of the other Disney parks has been first rate. Here it was simply awful. Of course it made up for the poor quality by being expensive and our having to wait in long lines to get it. Imagine 50 people in line for a simple ham and cheese sandwich. At most of the food places it was like McDonald's when ten tour busses stop at the same time. Mobs twenty people deep.

The entry fee to the park was about $50 each. Oh well, now we've been there and done that.

Do You Dare?

You've read about people who are so terrified of going out that they never leave their homes or apartments, even having all their food delivered. Well, many of us are imprisoned like that by our minds, keeping us from venturing out of our comfortable, self-constructed worlds. Our habits help imprison us. The aim of most of my editorials is to open doors for you so you can get a peek at what's out there in the way of adventure and excitement. Fun.

I try to entice you into trying new things. New ideas. New modes. New bands. I despair when I talk to hams who have spent their ham lives on just one band, or just with CW, or phone. Here, look, I say, how about trying this? And I point out that I know it's fun because I've done it. I've been there and done that, so I know you can, and I know you'll have a ball doing it.

Some readers react by saying, hey, maybe Wayne's right, I should give that a try. Others, looking for an excuse to do nothing, say that it's just Wayne bragging again.

My father was a difficult man. He made life miserable for my mother. If she prepared the same breakfast twice in a month he'd rage about getting the same thing every morning. So breakfasts were always a surprise. Fried mush with New Hampshire maple syrup, Philadelphia scrapple, eggs Benedict, poached eggs on New England red flannel hash, corn muffins,

corn pancakes, French toast, and so on.

It was the same for dinner. No restaurants provide such a varied menu as mother served. It might be bratwurst, pigs knuckles, turtle steaks, hash, roast pork, duck stuffed with peanut dressing, lamb shanks, and so on. Meals were an adventure. I don't think she ever served hamburgers or plain old hot dogs. It might be a ham slice with Boston baked beans and Boston brown bread.

I remember when I went on my first Boy Scout camping trip to Staten Island. They had forests over there. The other Scouts cooked hot dogs over their fires on pointed sticks. I brought along the makings and whipped up a delicious lamb stew over my fire. It never occurred to me to bring hot dogs.

So, here I am, doing my best to get you to enjoy some of the things I've enjoyed. Whenever I discover something that's fun or exciting, I have a need to share it. I want everyone else to experience that same feeling of excitement. So I write about the books I've read that are just too wonderful not to share. I write about hamming over our satellites. I write about scuba diving and skiing. They're both enormously exciting activities. The English language is terrible when it comes to trying to express feelings, so I don't know how to explain the thrill of being a good skier and heading down a hill at breakneck speed. Or racing a Porsche on the Nürburgring. Or going on an African hunting safari. Or exploring the fun of ham teletype. Or visiting Swaziland and Lesotho and getting on the air to tackle the pileups.

As I've mentioned recently, I finally sat down and made a list of the different ham activities. I was able to come up with 53 different activities that I've enjoyed, and 20 more that are still ahead for me. Every one of those is fun and it's a rotten shame that so many hams are stuck in one little corner of this grand hobby.

When I give talks I often ask for a showing of hands for different ham activities. How many here have made two meter aurora contacts? How many have been on our ham satellites? How many have ventured above 450 MHz? How many have mountain-topped on VHF? How many have worked over 300 countries? How many have won the Sweepstakes contest for your area? A DX contest? A VHF contest? How many have worked cross-band contacts? And so on.

Frankly, I get discouraged when I see so few hands go up. How many of you have been on a DXpedition somewhere? A couple hands. Doggone it. It doesn't cost much to go someplace and work the pileups. St. Pierre is near the east coast and easily accessible. The Caribbean is packed with small countries that'll generate pileups. If anyone thinks it costs a bundle to visit these places, they haven't been reading my editorials or my Uncle Wayne's Travels reports. Yeah, they're chintzy. I write the stories of my travels on my Macintosh, print 'em out, and then photocopy the reports. Well, they sell by the dozens, not by the zillions, so that's the only practical way to do it.

In my reports I show how thriftily (cheap) one can travel. How about a trip Sherry and I look to Munich, where we rented a car, drove to Vienna, Krakow, Prague, and back to Munich in the middle of the winter. We had first class seats flying over and back, and the whole works, including the car, hotels, some great meals, and wonderful visits with the hams in all those cities cost under $1,000. Impossible? Heh, heh, not when you know how to travel thriftily.

A couple of years ago we made a fantastic birthday present trip down through 11 Caribbean islands, meeting hams, getting on the air, and scuba diving most of the islands. The whole thing cost peanuts. Yes, I've written up day-by-day reports. I wrote 'em up for friends, but when I sent copies to some readers they wanted more for friends, so I made up a bunch and I've been selling 'em.

When Sherry and I arrived at the Mbabane airport, I said, "Wow, I sure wish there was some way to get more hams to visit a fantastic place like this!" I said the same thing when we visited a native longhouse in the mountains of Sarawak, complete with their enemy tribe's skulls hanging in the big meeting room.

Yes, I've eaten the poisonous blowfish in Japan and fried baby birds in China. I'm game for just about anything on the menu in any country. How about you? Hamburgers, eh? And are you the one who's been on 75m phone checking into the same net for the last few years? Are you the one stuck up there on 2m with a Tech ticket? I've been listening to you when I visit your area and I don't hear much different from what I'm hearing on CB, except that sometimes the language is worse on 2m.

Take a look through the ads and stick a toe outside the door. Try packet. Sure, it's scary at first, but then so is your first shark when you're diving. Pretty soon you'll be in the swing of it and having the time of your life. And as a diver you'll be surrounded by sharks and be just as excited. It turns out they're just other big fish, sharing the ocean with you. And then a huge manta ray flies by and you will never be able to describe the feeling that gives.

So I'm going to keep right on bragging about the things I've done that I've found exciting, hoping I can get you to reach for that door knob and peek out.

In my music magazines I've been doing the same thing. There's an awful lot of rotten music out there, and a few really exciting pieces. A few real gems. So I listen to as many new CDs as I can, and when I find something which really gets to me, I do everything I can to get others to at least give a listen. I'm put in mind of poor old Galileo, who couldn't get his fellow scientists to even take a look through his telescope.

Not that the situation is much different in the cold fusion field, where old-

line scientists who "know" that cold fusion is impossible because there's no theory which can explain it refuse to look at the results of laboratory tests. They "know" that if excess heat has been claimed to be produced, the experimenters must have made some stupid mistakes.

So you can put my urging you to try 75m DXing or working a few states on 10 GHz down to the same old Wayne's bragging, or you can accept it as I've been there, done that, and it's fantastic fun you shouldn't miss. I'd tell you (again) about the astounding CDs I've produced of Scott Kirby playing Scott Joplin's music, but my legions of detractors would claim that I'm just trying to make another buck. Since money has never been a driving force for me, that almost gets me upset. Don't you hate it when someone accuses you falsely? Surveys of entrepreneurs have always shown that they are driven by the need for results, and not money. So I'll keep trying to get you to enjoy the things I've found exciting and the heel-draggers will point in disdain at me bragging and trying to sell my book, booklets, CDs, and so on. Your choice. But you'll live a lot longer if you have fun with me than if you hate. And you'll be a lot better person with whom to live and work.

When I get angry letters, I'm sad because I know that this person is an angry person and I'm not the only target by a long shot. His wife, kids, and co-workers have to share his anger, and he's shortening his life.

Speaking of money, if it had been important to me, I'd probably have shot myself when someone I trusted did me out of over $100 million. I didn't smile, and it was a terrible shock, but I lived through it. I lived through a $20,000 fine from the IRS (over 20 years ago) for something that they knew I hadn't done. And I've lived through a more recent plot by some trusted employees to put me out of business and take my publications away. Heck, 40 years ago I lived through a partner destroying a $20 million business I'd built from scratch. And I'm still smiling and enthusiastic about doing new things.

For instance, I've been listening to Rush Limbaugh during my lunch-time drive to and from the office in Peterborough. He's got one heck of a big audience. Well, I think I can put on as good or better a show. I've got endless ideas on how we can fix most of our more serious social problems, such as how to eliminate drugs as a major American problem. How to cut our prison costs by at least 90% and have the criminals help fund our police and court costs. How to cut health care costs by over 90%. How to get our bureaucracies to cut their costs to us by 50% within three years and enthusiastically help to do it. How to make Congress actually turn honest. How America can provide almost any amount of foreign aid and make a mint doing it as well as improving the world. How to end welfare with everyone winning. Stuff like that.

A good positive approach to our problems might actually get people to start thinking in terms of improving our country and states, and to come up with even more creative solutions to our problems. I'm certainly not the only one who can do that. It's just that there is no forum for anything that's innovative.

I'd also be pushing hard to get every school in the country to form a radio club, and to help kids to get their ham licenses. But then, I'm anxious to completely reinvent our whole school system and make it so kids can go to college with no tuition required (and no public funding, either). I'd be reviewing exciting books I've found, great music most people have missed hearing about, and so on. I'm a pretty good salesman; otherwise, my talks at Dayton wouldn't always pack the room. I've always pulled the biggest crowds of any speaker. I'm enthusiastic. I'm selling fun and excitement. And I know what I'm talking about because I've been there and done that myself. I've done my homework.

A talk radio show sounds like fun, but Sherry points out that at 73 years old, and busy editing and publishing *73, Radio Fun, "Cold Fusion,"* and a bunch of other things, I haven't got the time to do a daily radio show also. She also points out that it took Rush years to build his big audience, and I probably haven't got that many years left. Further, a daily show would keep me from traveling. She's right. Well, maybe I'll just make some tapes of the shows I'd like to do, and settle for that.

I'll next be performing at the Edmonton Hamfest (Alberta, Canada) on July 1. Well, the Dayton HamVention gang seems to be so angry with me for not exhibiting for a couple of years that they're not about to ask me to speak. And the ARRL has always done all it could to keep me away from their conventions, and they control almost all of 'em. Unless there's a conflict with my schedule, I generally accept speaking requests where they'll pay my expenses. At one time I charged $1,000 plus expenses, but that brought me so many requests to speak that I had to stop charging. Jean Shepherd K2ORS, undoubtedly the best ham speaker in history by a huge margin, said he got far more attention and requests to speak once he set a stiff price on his time. And he was treated like royalty instead of dirt when he spoke.

What can I do, for instance, to get you to try your hand at using some of our ham satellites . . . and then writing about it so we can get more hams to try 'em? Or are you so used to eating the same breakfast every morning and hamburgers for lunch that your sense of adventure has atrophied?

Anyway, check out my travel reports in the Uncle Wayne's Bookshelf ad, and you might even want to suck in on my non-Dayton 90-minute tape talk. Or not.

Long Ago

When I first moved *73* to New Hampshire from Brooklyn in 1962, just

two years after starting it, I hired a bunch of college-dropout hams to come work for me. I paid $20 a week, plus room and board. I had up to eight hams living in my 40-room house and we had a great time. I cooked the meals, we put out the magazine, and we set up one heck of a ham station way up on Mt. Monadnock, a few miles away.

When I bought a small offset press, we started also putting out a small VHF magazine, a contester's magazine, and one for club newsletter editors. High school kids came in after school and helped collate, staple, and address these publications for 50¢ an hour. They got some spending money. It helped keep them out of trouble. And they got to learn about the responsibilities of working.

I had one ham working with us who was so much trouble that I finally gave up and tried to fire him. He pleaded with me to let him stay and keep working without any pay. Being a sucker, I said I'd give it a try. After a couple weeks I told him he wasn't worth anything. He then offered to pay me $20 a week if I'd let him stay.

I finally agreed to let him stay if he'd live in my house up on the mountain and help clean out the brush around the place. Just don't come down and aggravate us here. Well, for instance, I did the cooking and the live-in hams took turns washing the dishes. When it was Tedsy's turn he managed to turn a half-hour job into a four-hour job. The same when it was his job to empty the wastebaskets or shovel out the horse stalls.

Tedsy came down from the mountain one day and asked if I minded if he put up a vee beam for six meters, aiming it down the east coast. What could go wrong? I said sure. The next thing I knew a few weeks later he'd cut down a couple dozen big trees to make a path for the two legs of his vee beam. Worse, he'd miscalculated a bit and the beam was actually aimed at Bermuda, so no one down the coast could hear him.

I remember him walking up with a broken yardstick in his hand. He looked at me sheepishly and explained that he'd had it in his mouth and walked through a 30" door.

One day the government arrived. They'd had a complaint about my paying less than the minimum wage. I pushed them to find out where the complaint had come from and they said it was the ARRL in Connecticut. They said I'd have to stop paying the hams with the room and board and $20 a week, pay them regular wages, and charge them for the room and board. And the after-school kids would have to get at least the minimum wage.

I automated the collating and addressing of the publications I was printing, thus getting rid of the school kids. The hams were replaced by local people doing most of the work. No more room and board. No more fun. And without the gang to keep the ham shack up on the mountain operating, I closed it down and sold the place. Well, we all had the time of our lives while it lasted. Several of my alumni have gone on to be successful entrepreneurs.

You better believe that the lobbyists in Washington from Mexico and other low-wage countries are pushing congress hard to increase our minimum wage. Every dollar it goes up will mean millions for their countries, and more welfare and unemployment problems for us.

One alternative is to improve our school system so we'll have better-educated and better-skilled workers to enable us to compete more effectively internationally, but here we're up against the most powerful lobbies in the country, the teacher's unions. And they're unfailingly supported by the mass ignorance and apathy of voters.

Say, if we move the minimum wage up to $15 an hour we'll no longer have any poverty, right? Who could possibly be against that? If they move it to $20, I might even consider working again.

Help Wanted

Ham nirvana is "working" for a ham magazine, where you get to play with the latest in ham gear and help guide the whole hobby. We've a spot open for someone as an assistant tech editor. This will include updating the W2NSD/1 ham shack and getting it top notch with packet, satellite communications, SSTV, our repeater, our BBS, and one whopping signal on 20m. And how about a nice apartment we have available right next to the station? One with an incredible view looking out over the New Hampshire mountains? Yes, we'll actually pay someone to do this. We really should be charging for something this great.

If you're interested, drop me a line telling me about your ham experience, tower-climbing agility, and assuring me that you are *not* a smoker or an alcoholic. Address it to: *73* Tech Assistant, 70 N 202, Peterborough NH 03458-1107.

Get Rich Slowly

Getting your articles published in *73* and *Radio Fun* has a couple of benefits. Firstly, there's the pittance we pay for articles, which you can blow all out of proportion to your family and friends, proving to them that amateur radio not only is fun, but is profitable, too. Bene #2: If you ever go for a new job, you'll find that every published article you can show will, on the average, result in about $1,000 more per year in your paycheck. Nice cumulative benefit. A bonus is the adulation you will get on the air and at club meetings.

What kind of articles? Well, of course the most popular, even with parts so hard to find, are simple construction projects. DXpeditions and ham adventures make great reading, too. We're always looking for interesting reports on new equipment, plus any fairly simple modifications you think might benefit others. And I would like nothing better than to have some guest editorials I could publish (for free).

Number 27 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

AUG 6

WELLESLEY, MA The Wellesley ARS and the Babson Wireless Club will co-sponsor a Hamlesl at Babson College's Pepsico Pavilion, 9 AM-2 PM. VE Exams at 11:30 AM, (reg. by 11 AM). Exam fee is $5.90; make checks out to *ARRL/VEC.* Bring original and copy of your license, original and copy of any CSCEs held, a calculator and a pen. Talk-in on 147.03/.63 Rptr. Contact *Barbara Holdridge N1ICQ, 107 Church St., Westwood MA 02090; Tel. (617) 329-2628,* or *Gerry Driscoll NV1T, 107 Church St., Westwood MA 02090; Tel. (617) 444-2686.*

AUG 8-10

AUSTIN, MANITOBA, CANADA The Manitoba AR Museum will host a Hamlesl on the grounds of The Manitoba Agri. Museum at Austin. Huge Flea Market, Commercial Displays, Rabbit Hunts, and more. For info contact *Dave Syndal VE4XN, 25 Queens Cres., Brandon MB Canada R7B 1G1. Tel. (204) 728-2463.*

AUG 11-13

VERNON, BC, CANADA The 4th annual Sky High Hamfest will be held at Silver Star Mountain Resort. Sponsor: North Okanagan RAC. For details, contact the *North Okanagan RAC, P.O. Box 1706, Vernon B.C. Canada V1T 8C3.* For hotel reservations, call *1-800-663-4431.*

AUG 12

CHANUTE, KS The Chanute Area ARC will sponsor "Hamfest '95" 8 AM-2 PM at the Chanute Nat'l. Guard Armory, 3051 So. Santa Fe. Talk-in on 146.745(-). Contact *Jerry Young, (316) 431-3268, eves.; Charlie Ward, (316) 431-6402;* or *Ted Nantz (316) 537-6001.* For tickets and tables, make checks payable to *C.A.A.R.C.* by July 31st, and send to *Jerry Young KG0EM, 1333 W. Sycamore, Chanute KS 66720.*

DRYDEN, NY The 15th Finger Lakes Hamfest, sponsored by the Tompkins County ARC, will take place at the Dryden H.S., near the intersection of Rt. 13 and Rt. 38. Pre-reg. for VE Exams. Talk-in on 146.97(-). For details, call *Richard Spingarn AA2UP, (607) 387-5251 till 10 PM.*

HUNTINGTON, WV The Tri-State ARA will hold a Hamfest and Computer Show 9 AM-2 PM at the Cabell-Midland H.S., US Rte. 60, at Ona WV. VE Exams Flea Market. Emergency DARREN Packet Net. Talk-in on 146.76(-), 146.64(-), 146.52 simplex, and 444.85(+). Contact *Mike Taylor KB8GCA, (304) 429-1667.* Or write to *T.A.R.A., P.O. Box 4120, Huntington W.V. 25729.*

HURON, SD The Huron ARC will sponsor their 2nd annual Amateur Electronics Swapfest, 8 AM-3 PM at the Nat'l. Guard Armory, SD State Fairgrounds. Flea Market (setup at 7 AM). VE Exams 9 AM. Talk-in on 146.22/.82. Contact *Lloyd Timperley WB0ULX, P.O. Box 205, Huron SD 57350. Tel. (605) 352-7896 nights.*

RHINELANDER, WI The Rhinelander Rptr. Assn. and Northwoods ARES will hold their "Northwoods Hamfest" at Sugar Camp Town Hall in Sugar Camp., 8 AM-2 PM. Setup Aug. 11th 6 PM-10 PM; Aug. 12th at 6 AM. VE Exams 11 AM; reg. at 10:30 AM. Talk-in on 146.940(-). Contact *Mary Berger NS9Q, 367 Lois St., Rhinelander WI 54501. Tel. (715) 362-9296.*

QUINCY, IL The Western Illinois ARC will hold their Ham Radio and Computer Swapfest 8 AM-2 PM on the Eagles Alps Grounds, 3737 North 5th St. VE Exams at 12:30 PM; call *NA9Q at (217) 224-8526* to pre-reg. Flea Market. Tailgating. XYL Activities. Talk-in on 147.63/.03. Contact *Randy Jackson N9REY, (217) 223-7226.*

AUG 12-13

SILVER CITY, NM The Great New Mexico Chile Chase, sponsored by the Gila ARS, will run 1800 UTC Aug. 12th-1800 UTC Aug. 13th. For details, contact *NM Chile Chase, c/o Gila ARS, P.O. Box 1874, Silver City NM 88062.*

AUG 13

CHARLOTTE, NC The Charlotte ARC Hamfest and Computer Fair will be held 8 AM-4 PM at Roll-A-Round Skate Center, 8830 East Harris Blvd. For info, call *Buck Escott WB4OTP, (704) 522-4971, Ext. 3330.* Talk-in on 147.06(-).

ST. CLOUD, MN The St. Cloud Radio Club will hold its 47th annual Hamfest 8 AM-5 PM at Whitney Senior Center, Northway Dr. VE Exams on a first-come basis. Contact *W0SV, P.O. Box 141, St. Cloud MN 56302;* or packet *W0SV @ NF0H.#CMN. MN.USA.NOAM.*

AUG 17-20

SAN DIEGO, CA The California Computer Expo will run 9 AM-6 PM daily, at San Diego Convention Center, 111 West Harbor Dr. Computer Concerts. Art Contests. Virtual Reality. Weird Software. Much more. Registration deadline is July 31st. Contact *California Computer Expo, 1-800-573-3247* or *(619) 573-0617.*

AUG 18-20

HUNTSVILLE, AL The Huntsville Hamfest will hold the 1st annual Amateur Radio Industry Group Nat'l. Convention at the Von Braun Civic Center and the Hilton Hotel in downtown Huntsville. This is in conjunction with the 1995 Huntsville Hamfest and Alabama State Convention. A "Meet the Manufacturers" hospitality suite will open on Fri. at 5:30 PM at the Hilton Hotel. The Civic Center doors will open at 9 AM on both Sat. and Sun. Ask for special Hamfest rates at the Huntsville Hilton Hotel. Talk-in by K4BFT on 146.94(-) MHz, and 145.38(-) Rptr. For info write *Huntsville Hamfest, P.O. Box 12534, Huntsville AL 35815,* or call *(205) 534-7175.*

AUG 19

BURFORD, ONT, CANADA The Brantford ARC Flea Market will be held 8 AM-1 PM at Burford Fairgrounds. For table reservations contact *Richard La Rose VE3RLX, 153 Dunsdon St., Brandford Ont., Canada N3R 6N3. Tel. (519) 752-2437;* or write to *B.A.R.C., P.O. Box 25036, Brantford Ont., Canada N3T 6K5.* Talk-in on VE3TCR 147.150(+).

LONGVIEW, WA The Lower Columbia ARA, W7DG, will sponsor its 4th annual Ham Radio, Computer, and Electronic Equip. Swap Meet, 9 AM-3 PM at the Cowlitz County Fairgrounds in Longview. Setup Fri., 5 PM-9 PM; Sat. 6 AM-8:45 AM. Talk-in on 147.26(+), pi 114.8. Contact *LCARA Swap Meet, P.O. Box 906, Longview WA 98632;* or call *Bob KB7ADO, (360) 425-6076 eves.* Also, Email to *BobM326571@aol.com* or *75462.3215@compuserve.com.*

AUG 20

CAMBRIDGE, MA A Tailgate Flea Market (Amateur Radio, Electronics, Computer), will be held 9 AM-2 PM at Albany and Main Sts. For space reservations or into, call *(617) 253-3776.* Mail advance reservations before Aug. 5th to *W1GSL, P.O. Box 397082 MIT BR., Cambridge MA 02139-7082.* Talk-in on 146.52 and 449.725/444.725, pi 2A, W1XM/R. Sponsored by the MIT Radio Soc. and the Harvard Wireless Club.

MARYSVILLE, OH The Union County ARC will host the Union County Hamfest and Computer Show 8 AM-2 PM, at Broadway Ohio Community and Civic Complex. Flea Market. ARRL Booth. RC Model Airplanes on display (no flying). VE Exams at Taylor Township Hall (across the street from Hamfest); Reg. 9 AM-9:30. Talk-in on W8BJN 147.39(+) or KE8DQ backup Rptr. 145.35 pi 127.3. Contact *Gene Moore N8YRF, 24461 Claibourne Rd., Marysville OH 43040. Tel. (513) 246-5943.*

AUG 26

ALBUQUERQUE, NM The 1995 Duke City/New Mexico State Hamfest will be held at the New Mexico Army Nat'l. Guard Armory, 600 Wyoming Blvd. NE. ARRL VE Exams, contact *AA5MK, (505) 292-3218.* For Tables (prior to Aug. 21st), call *(505) 821-2771.* Internet queries: *WA5WHN @rt66.com.* Talk-in on KC5FT/KB5SF or 147.15 MHz Rptr. Send checks to *Duke City Hamfest, P.O. Box 6552, Albuquerque NM 87197-6552.*

ATHOL, MA The Mohawk ARC 3rd annual Amateur Radio, Computer Flea Market will be held rain or shine at Mohawk Drive-in Theater, Gardner MA. General admission at 8 AM; Setup at 6 AM. For advanced reg., send your name, address and phone number to *M.A.R.C., P.O. Box 532, Athol MA 01331.* Enclose $5 for each space you want to reserve. For more info, contact *John WF1L, (508) 249-5905, 4 PM-9 PM; Paul N1IPG, (508) 632-9432, 6 PM-10 PM; Tom N1KKY, (508) 249-4521, 5 PM-9 PM.*

BRIDGEWATER, NJ The Somerset County ARS, Inc. annual Hamfest will be held at the Somerset County 4H Center on Milltown Rd., just off of Route 202. Time: 8 AM-1 PM. Setup at 6 AM. Talk-in on 448.175(-). Call *Eric NW2P, (908) 753-8290.* Write *SCARS, P.O. Box 742, Manville NJ 08835.*

CHAFFEE, NY The Pioneer Radio Operators Soc. 4th annual Ham and Computer Fest will be held 7 AM-3 PM in Manion Park, located just off NY Route 16. Talk-in on 145.39. For a map and tickets, SASE to *Mike Wrona, 139 Greenmeadow Dr., West Seneca NY 14224.*

LIVERPOOL, NY The Radio Amateurs of Greater Syracuse will host their 40th Hamfest at the Academy Green American Legion in Syracuse NY. Flea Market setup 7 AM. Open to the public 8 AM. Commercial vendors 9 AM. VE Exams; leave message at *(315) 469-0590;* or write *RAGS, P.O. Box 88, Liverpool NY 13088.*

AUG 26-27

WOODLAND PARK, CO The Mountain ARC will hold its 14th annual MARC Campfest-Swapfest at Quaker Ridge Camp, 6.5 miles north of Woodland Park city center, on Hwy. 67 North (M.P. 82.5). Advance reg. essential; write to *MARC, P.O. Box 1012, Woodland Park CO 80866-1012,* promptly. Send an SASE for info sheet. Or, call *Don Chamberlain AA0NW, (719) 687-3692; Fred N0PKA or Patty N0PSD, (719) 687-9727.*

AUG 27

CORUNNA, MI A Five County Amateur Radio/Computer Swap 'N' Shop will begin at 8 AM at Shiawassee County Fairgrounds, 2900 E. Hibbard Rd. Setup at 6 AM. Flea Market. Trunk Sales. Talk-in on 147.020(+), or 146.520 simplex. For info, contact *Jan, (517) 893-3475.* Sponsors: Bay Area ARC; Genesee County RC; Lapeer ARA; Mid-Michigan Wireless Assn.; and Shiawassee ARA.

FOWLERVILLE, MI The Livingston ARK will host the Livingston County HamFair at Fowlerville Fairgrounds, Grand River Rd. (M43). VE Exams. Ham/Computer/Electronic Equip., new and used. Covered Trunk Sales. Flea Market. Time: 8 AM-3 PM. Setup at 6 AM. Talk-in on 146.680(-). When writing, send SASE. Contact *LARK, P.O. Box 283, Howell MI 48843;* or call *John, (517) 548-1412.*

LEBANON, TN A Special Event will be sponsored by the Short Mountain Rptr. Club, 7 AM-3 PM at Cedars of Lebanon State Park, US Hwy. 231, 7 mi. South of I-40. Outdoors only. Bring your own tables (spaces first-come, first-served). For details, contact *Thomas Page AD4AI, P.O. Box 2741, Lebanon TN 37086-2741. Tel. (615) 449-5610.*

SEP 1-3

COSTA MESA, CA The ARRL Southwestern Div. Convention (HAMCON '95) will be held aboard the Queen Mary, Long Beach CA. Contact *Chairman Nate Brightman K6OSC, (310) 427-5123.*

SEP 2

INDIANAPOLIS, IN The Hoosier Hamfest and Computer Show will be held 8 AM-3 PM at the Indianapolis Nat'l Guard Armory, Holt Rd. and Minnesota, off I-70. Sponsor: Electronic Applications Radio Service (EARS, Inc.). Largest Vendor Display in the area. Setup 6 AM-8 AM. Talk-in on 145.250 Indianapolis. *Contact Marty Hensley KA9PCT, 7205 Mohawk Ln., Indianapolis IN 46260. Tel. (317) 253-7985 eves.*

SPECIAL EVENT STATIONS

AUG 5

DULUTH, MN Doug KB9IES and Les WA0QIT will operate SE Station WA0QIT 1600Z-2100Z from Bayfront Park, as part of the 48th annual Duluth Internat'l. Folk Festival. Freq. will be 14.255 MHz. Send QSL with 9" x 12" SASE, or #10 envelope for a folded certificate, to *ARS - WA0QIT, 123 S. 65 Ave. W., Duluth MN 55807.*

AUG 6-12

POTTSVILLE, PA The Schuylkill ARA will operate an SE Station to celebrate the week of the Schuylkill County Fair. The Station will use the individual operator callsign with a suffix of "Schuylkill County Fair," or "/SCF" if operating CW. Operation will be both phone and CW in the Novice and the General subbands. For a certificate, please send an SASE to *Ed Brennan N3ILC, 520 Spring Garden St., Pottsville PA 17901.*

AUG 12-13

HAGERSTOWN, MD The Antietam RA will present the 1995 Maryland-DC QSO Party, 1600Z Aug. 12th-0400Z Aug. 13th, and 1600Z-2359Z Aug. 13th. Contact *Antietam Radio Assn., P.O. Box 52, Hagerstown MD 21741-0052.* Send logs with SASE by Sep. 10th.

SOMERSET, PA The Somerset County ARC will operate NJ3L from the highest point in PA at Mt. Davis. Operations will be 1700Z Aug 12th-2000Z Aug. 13th. Listen on the lower 50 kHz of the General class phone bands of 10-80 meters, as conditions allow. For a certificate, send QSL and SASE to *NJ3L, Dudley Daniels, RD 7 Box 270, Somerset PA 15551.*

AUG 18-SEP 4

TORONTO, ONT., CANADA The VE3CNE Committee will operate Station VE3CNE in conjunction with the Canadian Nat'l. Exhibition. All Amateurs visiting Toronto are invited to come to Exhibition Place and operate the station. The station will be located at the Internat'l. Pavilion, just inside the Princes' Gates at the east end of Exhibition Park. Operation will be daily from 10 AM-10 PM local time. During the day the local 80 and 40 meter phone nets will tell you where to find VE3CNE. CW: 80m 3.645-3.700, 40m 7.045-7.145, 20m 14.035-14.055, 15m 21.045-21.145. SSB: 80m 3.745-3.865, 40m 7.065-7.235, 20m 14.145-14.245, 15m 21.300-21.400. VE3CNE will also be found on packet, VE3CNE @ VA3BBS, and on the local rptrs. QSL cards will be sent to all contacts via the QSL Bureau.

AUG 19

FRANKFORT, NY The Fort Herkimer ARC will operate AA2AT, 1400Z-2200Z to commemorate the annual Herkimer County Fair. Operation will be in the General portion of 20m phone, and on 40m, the Novice CW portion and General CW and phone portions, and 2m packet. For a certificate, send QSL/SWL and a 9" x 12" SASE to *AA2AT Madeline Loiacano, 96 Grove St., Ilion NY 13357.*

AUG 19-20

BATAVIA, NY The Genesee Radio Amateurs will operate W2RCX 1300 UTC-2100 UTC Aug. 19th and Aug. 20th, to celebrate the 15th annual "1941 Wings of Eagles Airshow" being held at Genesee County Airport. Operation will be on 40m, 7.250 +/- 20, and on 20m 14.250 +/- 20. For a certificate, send QSL and a 9" x 12" SASE to *GRAM, P.O. Box 572, Batavia NY 14020.*

ENGLEWOOD, NJ The Englewood ARA, Inc. invites all amateurs the world over to take part in the 36th Annual New Jersey QSO Party, 2000 UTC Sat., Aug. 19th-0700 UTC Sun., Aug. 20th; and 1300 UTC Sun., Aug. 20th-0200 UTC Mon., Aug. 21st. Phone and CW are considered the same contest. Logs and comments should be sent to *Englewood ARA, Inc., P.O. Box 528, Englewood NJ 07631-0528.* Please include a #10 SASE for results. NJ stations are requested to advise EARA by Aug. 1st so that full coverage from all counties can be planned.

VANCOUVER, WA The Clark County ARC will operate Club Station W7AIA at the annual Northwest Antique Aircraft Fly-in at Evergreen Flying Field (just east of Vancouver WA). Tune In the lower portion of the General class band on the 80, 40, 20, 15, HF bands, and 2m, 146.52 for local contacts. The local 147.84/.24 Rptr. may also be monitored. For a certificate/QSL, send a #10 SASE to *CCARC, P.O. Box 1424, Vancouver WA 98668.*

AUG 20

FISHERS ISLAND SOUND, NY For only the ninth time in history, amateur radio is going to Flat Hammock Island. Tri-City ARC will mount this year's expedition and will operate KA1BB 1300Z-2000Z. Operation will be in the lower 20 kHz of the General class phone and CW bands, 20 and 40 meters. QSL w/letter size SASE via *Tri-City ARC, Box 686, Groton CT 06340.*

AUG 21

COLUMBIA, PA The Columbia Area ARC will operate from 1400Z-2100Z to commemorate the 100th Anniversary of the Bainbridge Band. Freq.: 7250 kHz, 7125 kHz, 14250 kHz, 14044 kHz, and 146.715(-) MHz. For a certificate, send QSL and 8 1/2" x 11" SASE to *Columbia Area ARC, P.O. Box 574, Columbia PA 17512.*

AUG 24-SEP 4

LIVERPOOL, NY The Liverpool ARC will operate K2YGF Aug. 25th-Sep. 4th from the New York State Fair. SSB and CW operation in the lower 25 kHz of the 80, 40, and 20m General sub-bands. Other bands and modes as conditions permit. For a certificate, send QSL and 9" x 12" SASE to *Liverpool ARC, P.O. Box 103, North Syracuse, NY 13212.*

AUG 25

WASHINGTON, DC Fleet Radio Pacific (FruPac), the Amateur Radio Operators of the Naval Cryplologic Veterans Assn. will operate N3GKE 1400Z-2000Z, from 3801 Nebraska Ave. This commemorates the move of Naval Security Group Headquarters to Maryland from Washington. Freq.: 7.234, 14.243 and 21.375 MHz +/- QRM. A 9" x 12" certificate will be issued to all who make contact and send QSL and SASE to *NU3D, 7801 Overhill Rd., Glen Burnie MD 21060.*

BANGOR, PA The Delaware Lehigh ARC will operate W3OK 1200Z-2400Z in conjunction with the 50th annual running of the Blue Valley Farm Show. Operation will be 40 kHz into the General phone portions of 80, 40, and 20 meters, and 28.400 MHz. CW contacts on request. 2m FM contacts on 146.580. A packet PBBS is planned for 145.090. Confirmed contacts can receive a QSL certificate by sending a 9" x 12" SASE to *DLARC QSL Manager, BVFS Special Event, RR #4 Greystone Bldg., Nazareth PA 18064.* Please send sufficient postage.

SEP 2

CONCORDIA, KS The Kansas-Nebraska ARC will operate W0OYA to commemorate the 50th Anniversary of the end of the War against Japan. The Station will operate from the home stations of W0TQ and W0NBT, which are near the World War II German POW camp. Phone: lower 25 kHz of the General phone portions of 40, 20, 15, and 10 meter bands, 1600Z-2300Z; and 80 and 75 meter bands from 2300Z-0300Z. For a QSL certificate, send QSL and large SASE to *Kansas-Nebraska ARC, c/o Arlan Campbell W0NBT, Rt. 3 Box 20-A, Concordia KS 66901.*

SEP 2-4

CASPER, WY The Casper ARC will operate Station W7VNJ 1800 UTC-2400 UTC each day, to commemorate the 100th Anniversary of the first oil refinery in Wyoming (at Casper). SSB operation will be in the bottom 50 kHz of the General portion of the 75, 40, 20 and 15 meter bands, and in the Novice portion of the 10 meter band, conditions permitting. For an 8" x 11" certificate, please send QSL card and 9" x 12" (for flat), or business size (for folded) SASE to *CARC, Special Event, P.O. Box 2802, Casper WY 82601.*

WATERFORD, CT The Tri-City ARC will operate KA1BB from the Waterford CT I-95 weigh station, to promote safe Labor Day holiday auto travel. This event is in conjunction with the 6th annual Stay-awake Coffee Stop sponsored by the BSA Troops from Niantic CT. Operation will be 1700Z Sep. 2nd-1800Z Sep. 4th, in the lower 20 KHz of the 80, 40, 20, and 15 meter General class phone and CW bands. Talk-in to Coffee Stop on FM 146.52 direct, and CB Channel 19. QSL with letter size SASE, via *Tri-City ARC, P.O. Box 686, Groton CT 06340.*

Number 28 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)—comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to the Barter 'n' Buy, *73 Magazine*, 70 Rt. 202N, Peterborough NH 03458, and get set for the phone calls.

The deadline for the October 1995 classified ad section is August 10, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

WANTEDWestern electric amplifiers, tubes, speakers & parts. Free Quote! 1-800-251-5454. BNB268

COMMODORE 64 REPAIR. Fast turn around. **SOUTHERN TECHNOLOGIES AMATEUR RADIO,** 10715 SW 190th Street #9, Miami FL 33157. (305)238-3327. BNB295

KENWOOD AUTHORIZED REPAIR. Also ICOM, Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322. BNB310

NOW ON 40 METERS! New, knob-tuned w/digital display, synthesized QRP transceiver. Complete kit only $199.95. S&H $7.50 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

REPEATERS VHF/UHF/220, Built from GE Master-II Mobiles. Tuned to your frequency. Starting $249. **Call evenings,** (503) 378-0646, E-Mail: Ham440@aol.com. BNB335

RCI-2950/2970: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT**, P.O. Box 510408, St., Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

HR2510, RCI2950, CONNEX 3300, COBRA 148, GALAXY SATURN, plus many more kits to increase your modulation, $19.95. **(800)536-0109.** BNB350

IT'S BACK! The return of the HW-8 Handbook! Second printing. Modifications for the Heath QRP rigs. First class mail $11.

Number 29 on your Feedback card

PROPAGATION

Jim Gray W1XU

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

Conditions This Month

Radio propagation this month is likely to make DXers, who have only weekends to hunt for rare ones, very unhappy. The really Poor days of the month of August are likely to be 4–7, 14, and 19–22. The Best days are possible on 1, 9–11, 25–27, and 31. The remaining days are trending one way or another through Fair. It is also possible that there may be some severe weather and other geophysical upsets on 5-6, 14, and 20-21. Listen carefully to WWV at 18 minutes after any hour for the latest updates on "conditions" and special alerts. It would be worthwhile also to monitor weather channels on the dates mentioned above.

10, 12, and 15 Meter Bands

Sporadic-E propagation on many (G) or (F) days, with good signal strengths of short duration and quick fading. The ionized clouds drift with the high-altitude winds. Expect skip to 1,500 miles or so, and beam across the equator for possible contacts in the opposite hemisphere. These bands will close at sunset.

17 and 20 Meter Bands

Twenty will be best, and sometimes 17 will be almost as good, but not as heavily occupied. If open, the higher-frequency band will provide the longest skip. Twenty will remain open after sunset and sometimes late into the evening. Seventeen will close at dark or shortly after. Possible grey-line DX along the terminator is a bonus.

30 and 40 Meter Bands

Excellent nighttime possibilities on evenings when QRN is low and "conditions" are Good. Thunderstorms between you and your target can make copy difficult, if not impossible. Daytime short skip out to 1,000 miles is frequent, and nighttime skip to 2,000 miles or more will occur less regularly. Thirty meters will behave more like 20, and 40 meters will behave more like 80 on many occasions, due to the height of the reflecting layer at that time. Always check the next-higher and next-lower bands.

80 and 160 Meter Bands

Expect lots of QRN. You'll hear very few signals on 80 during the day, and none on 160. These bands are the nighttime bands in summer, and it pays for you to keep a sharp ear open after sundown. On particularly good nights with low noise, you will find both long skip and DX on both bands. Avid DXers must be patient, however, because in summer there's almost always noise present. I'd recommend that you use the long summer days and evenings for building up better antennas for these bands, and wait until fall for conditions to improve. 73

JUNE 1995						
SUN	MON	TUE	WED	THU	FRI	SAT
		1 G-F	2 F	3 F-P	4 P	5 P
6 P	7 P-F	8 F-G	9 G	10 G	11 G-F	12 F
13 F-P	14 P	15 P-F	16 F	17 F-G	18 G-F	19 F-P
20 P	21 P	22 P-F	23 F	24 F-G	25 G	26 G
27 G	28 G-F	29 F	30 F-G	31 G		

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						20	20					
ARGENTINA	20	20	20	40			20	20	15	15	15	15
AUSTRALIA		20	20	20	40	40	20					
CANAL ZONE	15	40	40	40	40¹	40		15	15	15	10	10
ENGLAND			40¹	40			20	20	20	20	20	20
HAWAII			20		40		20					
INDIA												
JAPAN						20	20					
MEXICO	15	40	40	40	40*	40		15	15	15	10	10
PHILIPPINES							20					
PUERTO RICO	15	40	40	40	40¹	40		15	15	15	10	10
SOUTH AFRICA			40	40		20	20				20	
U.S.S.R.							20	20		20		
WEST COAST	20	40	40	40¹	40¹	40						20

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA		20	20					20	20			
ARGENTINA	15	20	20	40			20	20		15	15	15
AUSTRALIA	15	20	20	20	40*	40		20			20	
CANAL ZONE	15	20	20	20	40¹	40	20	20	15	15	15*	10
ENGLAND	20	40					20	20		20	20	20*
HAWAII	15	15	20	20	20	40	20	20				
INDIA												
JAPAN		20	20					20	20			
MEXICO	15	20	20	20	40¹	40	20	20	15	15	15*	10
PHILIPPINES		20	20				20	20				
PUERTO RICO	15	20	20	20	40¹	40	20	20	15	15	15*	10
SOUTH AFRICA							20				20	20
U.S.S.R.								20			20	

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA		20	20						20			
ARGENTINA	15	20	20	40	40			20	20		15	15
AUSTRALIA		20	20	20	20	40¹	40¹		20		15	15
CANAL ZONE	15	15	20	20¹	40¹	40		20	20	15	15	15
ENGLAND	20							20	20			20
HAWAII	20	15	15	20	20	20¹	40*	40	20		20	20
INDIA				20					20			
JAPAN		20	20						20			
MEXICO	15	15	20	20¹	40¹	40		20	20	15	15	15
PHILIPPINES				20					20			
PUERTO RICO	15	15	20	20¹	40¹	40		20	20	15	15	15
SOUTH AFRICA			40						20			
U.S.S.R.									20			
EAST COAST	20	40	40	40¹	40¹	40						20

¹Check next higher band
*20 Meters possible on good days [illegible]

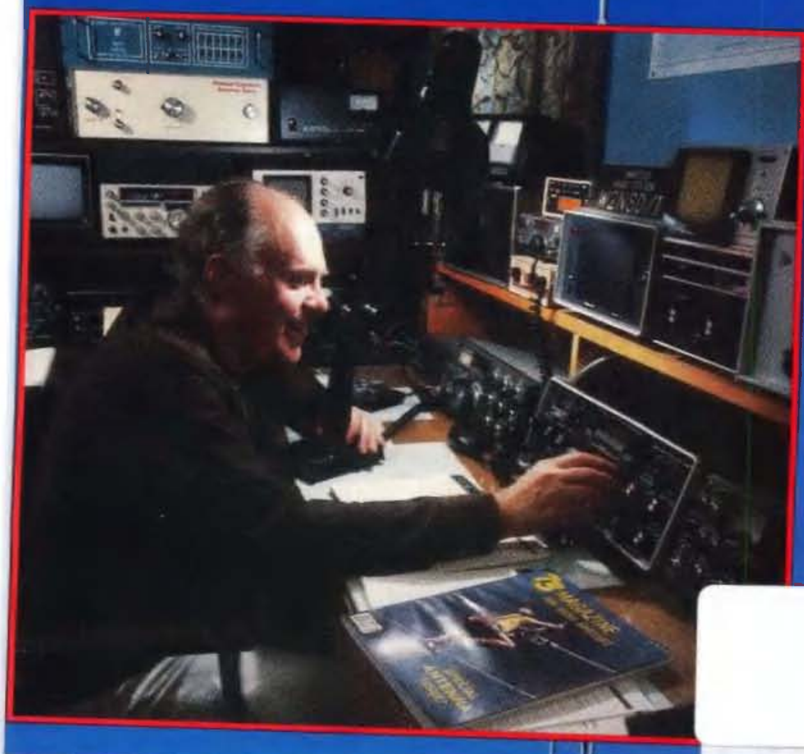
73 Amateur Radio Today

SEPTEMBER 1995
ISSUE #420
USA $3.95
CANADA $4.95
A WGI Publication
International Edition

35th Anniversary Issue

ANTENNAS!

Loop Antenna · Discone Antenna
J-Type Vertical Antenna · Bridge Checkers
Longwave Plus DX · Tuners



73 REVIEWS

Sony ICF-SW100S Pocket SW Transceiver

Icom IC-738 HF Transceiver

73® Amateur Radio Today

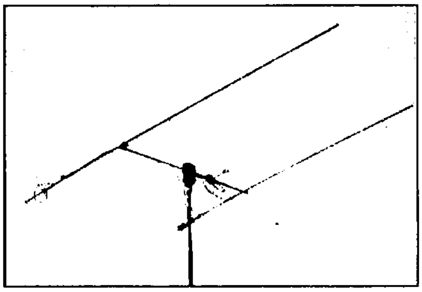
September 1995
Issue #420

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

REVIEWS



Two large KLM crossed Yagis and a Bob Myers "S" dish for Field Day sattellite work. See Hamsats on page 64.

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: That's vintage Wayne in the hamshack. Sure been at it awhile, spreadin' ideas all over the air. And behind him is a pair of Cushcraft Model A3S antennas that can help do the spreadin'.

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. Entire contents © 1995 by Wayne Green Inc. No part of this publication may be reproduced without written permisson of the publisher. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693

Contract: You have now been legally obliged, by the mere act of reading this, henceforth to act with all the duties and responsibilities befitting the status of a human being. You must now behave with dignity and kindness toward all beings, honoring the ancient and educating the young. And if you're obnoxious on the air, my cousin "Big" Bruno's gonna find you with his Doppler.—Vic

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Ooops!

In my July editorial I mentioned the Virginia Beach Hamfest as being in July. Wrongo! It's September 23–24 and, il you are within any kind of driving distance, I expect to see you there. No excuses. Yes, of course, I'll be talking. And talking. Well, I kept 'em entertained for a couple of hours at the recent Edmonton hamfest. More like three, I guess. Nobody left and everyone was laughing. I'll be at the Queen Mary hamfest over Labor Day, but I haven't been asked to speak (yet). I'll try to bring some tapes to tide the deprived over if the ARRL can't find any time for me on their program. I'll have some of my books there to autograph, too.

Good Grief, 35 Years!

When I started publishing *73* with the October 1960 Issue, I was too busy living in the present to even imagine that 35 years later I might still be at it. It was something which I felt was needed at the time; something I enjoyed doing. So I sold everything I could and scraped just enough money together to print the first issue. That's the sort of a gamble only a naive entrepreneur would make.

At 38, it never occurred to me that I'd still be publishing the magazine when *I* was 73. But then, who really plans their future out for years? I took opportunities as they presented themselves, with little thought to the long run, other than investing in building as many skills as I could and reading endlessly.

The big landmarks in my life were my interest in amateur radio, which began in earnest in 1938; my four years in the navy during WWII and the superb electronics education I was provided; my interest in Dianetics in 1950, which was a major turning point for me; my first entrepreneurial adventure: manufacturing loudspeakers; my entry into ham publishing, starting *73* in 1960, FM and repeaters in 1969, and microcomputers in 1975; the sale of my microcomputer empire and entry into the music business in 1983; my involvement with the New Hampshire Economic Development Commission in 1991; and my venture into cold fusion in 1994.

It was amateur radio that got me to go to Rensselaer Polytechnic Institute, and then into the navy as an electronics technician. This led to me working for Airborne Instruments, doing R&D for the Air Force, where I took a new microwave antenna design and applied it to loudspeakers. It was amateur radio that got me into publishing, starting with a RTTY newsletter in 1951.

Amateur radio has brought me thousands of friends and years of enjoyment.

Psychokinesis Anyone?

You no doubt missed the article in the April *Wired* on the Princeton Engineering Anomalies Research (PEAR) laboratory, where they have confirmed the ability of minds to influence matter. It turns out that about two-thirds of the people tested were able to influence random events. Of course, there were a few people who are completely off the charts. Endless tests have shown that it doesn't make any difference where the people are being tested. The effect works just as well in the same room as halfway around the world or out in space.

I remember a video of a psychic changing the surface tension of a jar of water from hundreds of miles away. This was shown at the ISSSEEM (subtle energies) conference in Monterey in 1993. I hope to have more to report on this year's conference in Boulder (which by now you've missed, despite my entreaties to attend). The same psychic was able to disturb a cloud chamber from afar.

But then, if you've been getting the books I've recommended, you know about the incredible ability of your cells to keep in touch with each other, no matter how separated they are from you.

Now, to put this in ham terms, please don't tell me you have nothing more to talk about on the air than your rig and antenna. Or the weather. There's a whole world out there that we're just beginning to explore. We don't know how the mind works. We need to know more about death . . . and never mind what your religion has taught you. When millions of people over thousands of years have a near-death experience and then come back to report similar experiences, it's almost enough to make a person think.

I talked with a chap in Florida who claims he can teach people to move matter with their minds. He says he can spin a whole room full of pizza pans from anywhere he is, and has done it under the most carefully checked scientific circumstances.

One of the problems with exploring the mind and consciousness is the number of people taking advantage of the vacuum of information in this field. They're out there waiting to take advantage of the gullible at every turn. But if you throw the baby out with the bathwater, you're just refusing to explore uncharted territory . . . if you don't mind my metaphors.

One only has to look at the endless examples of scientific resistance to evidence to begin to question our authorities. I've written about stomach ulcers, in which the medical establishment refused for years to even look at the evidence that they might be connected to a microbe: *Helicobacter pylori*.

The more you read about carefully researched near-death experiences (NDEs), angels, contactees, UFOs, reincarnation, and so on, the more you realize that thousands to millions of people have for some reason been having similar experiences all over the world. What do you know of the research of Sir Crookall, Wilhelm Reich, Royal Rife, Gaston Naessens, and other unsung pioneers?

Homeopathic medicine was a big and successful healing art here in the 19th century. My great grandfather was the town doctor for Littleton (NH) and was still being talked about appreciatively by the townspeople when I was a kid, 30 years after his death. He was a homeopath. Now, if you've been keeping up, you know that allopathic doctors mounted a battle against the homeopaths in the 1920s and put them out of business in America by taking over all of the American teaching hospitals. However, homeopathy still lives in England, where recent double-blind research has shown that the basic theory does work, though there is no scientifically accepted explanation for how.

The more I read, the more convinced I am that millions of people are suffering and dying needlessly, all as a result of the AMA-FDA and the supporting insurance companies refusing to look into even the strongest of research data on alternatives to the use of drugs and surgery as a solution to our sickness problems.

Oh yes, lest I forget. If you have some unfortunately overweight people in your ham club, you could help add quite a few years to their lives by getting them a subscription to *73* and let me keep after them to give up their beer and doughnut diets and shift more to fruits and veggies. No, I'm not a vegetarian or anything. But it doesn't take a rocket scientist to figure out that your body has to keep rebuilding itself from the food you eat, so it's going to last a lot longer if you provide what it needs. Coffee and danish are new additions to our diets. The human body developed over the millennia to work on meat, vegetables, and fruit, not Dunkin Doughnuts, beer, Big Macs, and fries.

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Joseph Falcone, Att'y (no call given) I have been reading your *73* editorials for some time now. At first I thought you were simply "off-the-wall" and interested solely in eliminating amateur radio Morse Code exam requirements so you could sell more magazines and other stuff to more licensees.

But, after reading your editorials, I realized that you are in fact a visionary who is quite upset that people in America, including amateur radio operators, appear to be content to sit on their butts and let the world pass them by. You consistently point out that commercially connected computers can pass information millions of times faster than some amateur radio modes, and you urge the amateur radio operators to forget about long boring 75 meter phone QSOs and allegedly "meaningless" CW QSOs. But, Wayne, you are missing the point. Amateur radio is not going to compete with the Internet or cellular phones in efficient ways to communicate. Those modes of communication have passed by amateur radio in pure efficiency and capital investment. What amateur radio has that the commercial communication operations will never have is: (1) amateur radio operators who volunteer to be mobilized in an emergency to provide true "emergency" communications; and (2) the ability to provide education and training to America's population about basic electronics.

By keeping CW in use, amateur radio provides a means by which its participants can build and use very basic equipment to communicate. Let's face it, the average person will not be able to design and build a new, improved 486 computer chip, with its three million transistors. But, the average person can build a small QRP transmitter and learn how transistors and other basic components work.

Back in the 50s you and amateur radio were in the forefront of technology. Today, that just is not so, and will likely never happen again. Smell the roses, Waynel Our store-bought equipment is so complicated today that we are lucky if we can figure out how to use it, much less understand how it really works. Forget about actually building a TNC or 2 meter HT. That simply does not happen any more, and will never again.

If we want to keep amateur radio valuable to this country, and not just a cheap way to get around using cellular phones and long-distance telephone lines, we must promote the use of CW in amateur radio to insure that the hobby is not simply a group of people who like to chat on the two meter repeater systems that Uncle Wayne invented 20 years ago. Are the two meter repeater operators any more productive than the windbags on 75 meters you so disdain?

All the "hot" technology is in the UHF/VHF area. The UHF and VHF amateur radio bands are "code free." All the "scientists" that you and others say want to rush into amateur radio, but are prevented because of a 5- or 13-wpm Morse Code requirement, can easily obtain a no-code license and can experiment to their hearts' content on the higher bands. Just allow the old HF bands to be the training ground for people who want to know why electronic things work, rather than what the buttons do.

When I look at the main Japanese ham magazine, running 500-600 pages every month, packed with innovative and some highly advanced construction projects, I see what American hams used to be able to do—and you claim they will never again. But then the Japanese have not been saddled with the code requirement for decades. Joe, I have never had any quarrel with the code as a way to have fun, only with using it as a way to freeze out new hams, which it has done and is still doing very effectively. Maybe you haven't noticed that over 50% of the American hams today are Novices or Techs. For some weird reason you seem to believe that the only way you can get hams to use CW is to force them by law to learn the code. How typical of a lawyer! I have a news flash for you, Joe, the need for ham emergency communications is dwindling. Our ability to provide basic electronic training has been almost totally destroyed by the ARRL memorization system for passing license tests. So I'm sitting up here in the beautiful mountains of New Hampshire smelling something, but it isn't roses, as more and more Americans become lawyers instead of engineers. Have I really missed the point? . . . Wayne

Cecil Moore KG7BK I've just got to take issue with your June review of the SGC-230 automatic antenna tuner for mobile operation. You say it doesn't work well in the trunk. Well, then don't install it in the trunk. You say it doesn't work well with coax. Well, then don't use coax. Implying that it's not a good *automatic* tuner for mobile use is just not true. It sure outperforms my old system on the higher bands. Since it's weather-proof, it is logical to install it on a grounded rod mounted to the bumper. Mine is a 5/8" piece of threaded rod bolted to the trailer hitch hole. A standard antenna mount is located at the top of the grounded rod. My antenna is a 13-foot whip fed by 2 inches of wire from the SGC-230. There is no coax involved. The whip is a resonant quarter-wave on 17m and does an excellent job on 20m. It outperforms my old tuner on 15m, 12m, and 10m because of the gain associated with an antenna longer than a quarter-wave. The 13' whip and the SGC-230 is only one S-unit down from a resonant Bugcatcher on 40m. I hope SGC doesn't lose any sales because of your disinformation. It is an ideal solution for l0m-20m automatic tuning mobile operation.

John Slivka WA2X I want you to know that I really appreciate your column every month in *73*, and I view your position as really the chief spokesperson for amateur radio. Keep the great ideas flowing! I've wanted to write to you for a long time because I'm concerned about the future of ham radio and the spirit of camaraderie and good will which have always been associated with it. We need to keep fostering friendly on-the-air contacts. I recommend that we make sure to say something positive during each QSO. This will have a ripple effect, helping to make hamming more fun for everyone. It might even lead to your running for president of Ihe ARRL, making it possible to break up the old-timers now running our national organization. Keep up the good work. Your magazine is an inspiration to me.

The ARRL presidency is for someone who has a need to feel important. It's a figurehead job I haven't time for, but thanks for the kind words and the thought. I really like your idea of being positive on the air. But then ham camaraderie still lives in many parts of our country where hams gather to help a fellow ham put up his tower. I just wish I'd get more good pictures of things like that . . . Wayne

Richard Mollentine WAØKKC Wayne, *there seems to be a* "new breed of hams." They argue, cuss (those four-letter words) on the ham bands and are determined to start an argument over anything, not an adult discussion. Surely ham radio wasn't planned and licensed for that kind of stuff.

Unfortunately, the FCC has not included a sanity section in the license tests, so we have our crazies. I'm open to any creative suggestions from readers on how we should handle nasty hams, and I've run into my share of them. This seems to increasingly be a challenge for us. And the solution is up to us, not the FCC. Are we "self-policing," as we keep bragging? Well, that's up to you. In coming up with creative approaches to things like this, keep in mind that the angry person is expressing a deeply felt inferiority and is overcompensating by putting people down as a way to build himself up. Let's not set out to really get even with these sickos . . . like sending perfumed letters to him at home thanking him for making your visit to his town so memorable and signing it with a woman's name. That might require some explaining to his long-suffering wife. Tsk. If you have a phone ROM, you could send letters to his neighbors asking them to tell him to cut out the nastiness over the air. Now, put on what's left of your thinking cap after the mice and moths have had at it all these years, and let's see what you can come up with . . . Wayne

QRX . . .

Number 3 on your Feedback card

TNX

Wayne Green and all the staff of *73 Amateur Radio Today* want to extend our deepest gratitude to all our writers, advertisers, past and present employees, and, most especially, *you*, our readers. It's been a great 35 years! May we all be together for 35 more.

An International Adventure

This piece from Rajiv Dewan AA2UI. I recently installed an HF rig in my car and rediscovered the joys of HF mobiling. It was a rainy day when I left for work around 8 am on Tuesday last. I backed out of the garage, stopped and installed the three-foot whip on the Hamstick. The antenna with the whip is too tall for the garage. Serious QRM greeted me as I settled in the car seat and turned on the radio. My mobile rig is a Kenwood TS-50s that is mounted in the passenger seat well of a Saturn sedan. It is mounted to the side of the gear shift console so the radio faces up and is easily seen. The controls are within easy reach. Its power cord goes directly to the battery, with both leads fused. The antenna is a 30m Hamstick mounted to the tow hitch at the back of the car. I am most pleased about my keying arrangement. The paddles are tiny brass ones, called Einbau Wabbler, which are imported from Germany by Electro Switch of Atlanta. The paddles are mounted on a small die-cast aluminum box containing the CMOS Super II memory, keyer, and keyer batteries. The whole keyer and paddle assembly is mounted on a 'C' shaped leg clamp from a WWII J45 key used by aviators. I attach the clamp to my leg just above the knee so that the paddles are near where my right hand rests near the gear shift lever. The setup makes it quite easy to send without ever having to look at the paddles and keyer assembly. It is just as effortless as holding down the PTT switch of a microphone.

Back to the rainy day. I was on a street about half a mile from a highway entrance ramp when I caught the fragment of a QSO: "JOE QTH CHIBA." The QTH sounded exotic and the signal had a watery, over-the-pole flutter DX quality to it. It was JA1LZR in QSO with a W1. When Joe finished his QSO I quickly reached down and sent AA2UI/M twice. A roar of WI and W4 calls greeted me as soon as I stopped transmitting. I was not the only one calling him. Much to my surprise, I broke through the pileup. It must be the 5 dB/M advantage. I was merging with the traffic on the highway as Joe came back to me. I needed to shift from fourth to the fifth gear before I got back to Joe or I would not be able to hear him amid the engine scream. Fortunately, the pileup wasn't impatient and no one took advantage of the slight delay. I merged into the center lane and started my QSO. Joe's signal was quite strong and so I assumed that I would be getting in quite well into Chiba, which is on Tokyo Bay, just east of Tokyo. Joe came back with a strong signal that provided clean copy despite the QRM. He was putting 400 watts into an inverted vee and it was enough to communicate despite my compromise mobile antenna made of spirals of wire wound on a fiberglass rod and a steel whip. Joe's signal began to fade as I went down the exit ramp and was almost lost as I turned on to the surface street. I thanked Joe for the QSO and signed. Little did Joe know that I was thanking him not just for the QSO, but also for starting my day off with a bang—a DX QSO. It sure beat listening to traffic complaints on the local 2m machine! *Reprinted from the North Shore Radio Club* Transmitter.

French Fry Fox Hunting?

I've been goofy about fox hunting, whether hunter or huntee, since before they invented sunspots. I was once in a club that ran a fox hunt every Sunday, rain or shine, on 10 meters. They started with transmitters hidden in bushes, but soon progressed to the ridiculous. Like "mag mounting" a transmitter to the side of a bus. The guy who did that was forbidden from ever again hiding the transmitter. Another member got his muscle-bound, six-foot two, brother to park in a car with the transmitter and snarl at anyone who approached.

One incident sticks in my mind as sneaky even by that club's standards. A technically adept brother built a transmitter only an inch or two on a side—the first transistorized transmitter I'd seen that would fit inside a bag of french fries. He concealed the antenna by threading it through a long fry that stuck out of the package. He selected me to talk into the transmitter, so I enlisted an actor friend to provide me with a disguise. After an hour of preparation, I took a seat in a local fast-food emporium.

Soon the hunters appeared outside. They circled the restaurant for some time, aiming their directional loops this way and that. Finally one of them got up the nerve to bring his equipment inside. Instantly, the manager rushed out and asked if they were a bomb squad. After convincing him they were only deranged hams, they searched the dining area. They were on their way back outside when they passed near me—just as little girl at the next table shouted, "Daddy, why is that man talking to his french fries?"

TNX to Jim Reed KD3S via Maryland Radio Center, Indiana County ARA's The Sine of the Times, *and the ARNS* Bulletin.

Astronomer Joins Alien Search

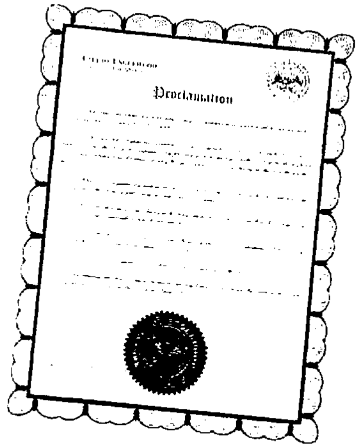
The director of the Ohio State University Radio Observatory has been appointed a technical advisor to The SETI League, Inc., in the Search for Extra-Terrestrial Intelligence. Ohio State professor Dr. Robert S. Dixon's considerable expertise will help the organization to privatize research once conducted by NASA.

The Ohio State radiotelescope, affectionately known as Big Ear, was home to a mysterious microwave signal detected on August 15, 1977. Known thereafter as the "Wow!" signal (after a single word scribbled in the margin of the computer printout by researcher Jerry Ehman), it exhibited all of the expected characteristics of a coherent signal of intelligent extraterrestrial origin. Scientists consider the "Wow!" signal to be the best evidence to date of the existence of other technologically advanced civilizations in the cosmos. Although it has stood up to eighteen years of scrutiny, it has never reappeared. Dixon and his SETI League colleagues hope to detect additional "Wow!"-type signals.

SETI seeks to determine through scientific measurements whether humankind is alone in the universe. Congress terminated all of NASA's SETI funding in late 1993. Experimenters interested in participating in a privatized search, or citizens wishing to help support it, should contact The SETI League, Inc., membership hotline at 1(800) TAU-SETI. The SETI League, Inc., is a membership-supported, nonprofit educational and scientific corporation dedicated to the electromagnetic Search for Extra-Terrestrial Intelligence.

ARRL President Resigns

George Wilson W4OYI, 63, who was incapacitated by a stroke last February and is still in the hospital recuperating, resigned in July as the ARRL president. Filling his place until the end of his term in January is Rodney Stafford KB6ZV of San Jose. Rod is now a Santa Clara County municipal judge, after lawyering for 18 years.



The Certificate of Proclamation by the mayor of Englewood, NJ.

Englewood Proclamation

The mayor of Englewood, New Jersey, has issued an Englewood Amateur Radio Association Week proclamation for the 34th consecutive year to celebrate the club's outstanding Field Day activity, where they've won first place in their transmitter category for 30 of the last 32 years.

Simple J-Type 10m Vertical

For more versatile DXing.

by John C. Reed W6IOJ

The main advantage the vertical HF antenna has over its horizontal counterparts is its low-angle radiation pattern. This is important on 10 meters, where success often requires low-angle radiation propagation. Another advantage of the vertical antenna is its unobtrusive profile. You can use it in locations, such as on a city lot, where many other antennas would not fit, or would be considered an eyesore by the neighbors.

The main negative feature of verticals is that ground path radiation is dominantly vertically polarized, making this type of antenna sensitive to interference from such sources as automotive ignition noise. If, however, your environment is fairly noise-free, as is mine, then the vertical may just be for you!

Entry-Level Construction

This is a simple antenna project any do-it-yourselfer can put together. All the parts are available from Radio Shack and your local hardware store. The assembly includes an easy-build balun-matching transformer. Also described is a simple SWR directional coupler so that you can accurately match the antenna to a 50-ohm feedline.

10m "J" Overview

The diagram in Figure 1 shows the configuration and lists the materials. The 1/2-wave radiator is a 1/4-wave whip antenna connected to a 1/4-wave wire inside a plastic PVC pipe. The wire end of this 1/2-wave assembly is matched to a 50-ohm transmission line with an open wire 1/4-wave stub with a balanced to unbalanced balun. In the normal J-type antenna the 1/4-wave stub is part of the vertical structure. My antenna worked well with the stub close to perpendicular to the ground; you may want to experiment with this angle for best results.

As indicated in Figure 1, the stub wires are spaced 1 1/2" with plastic spacers at 1-foot intervals. Although I used glass epoxy for the spacers (etched PCB), Plexiglas (TM) works just as well. Drill the spacers with wire clearance holes at each end, temporarily hold them in position with small pieces of masking tape, and then fasten them with a spot of all-purpose adhesive.

Figure 2 depicts the simple method of mounting the whip antenna in the plastic pipe. Although I used glass epoxy for the indicated plastic washers, you can use any hard plastic.

The balun transformer detailed in Figure 3 converts the single-ended, 50-ohm transmission line to a balanced 200-ohm output for interfacing with the 1/4-wave antenna stub. The transformer consists of

A) 8ft 6in whip antenna (RS 21-903).
B) End coupling (see Figure 2 for details).
C) 8-ft.3/4 in plastic pipe (PVC 1120 PR200-200 PSI).
D) 6-ft. 1-in x 2-in wooden dowel, which supports for plastic pipe).
E) 2" wide duct tape, which fastens pipe to wood support.
F) 2" x 2" wooden dowel.
G) Stub and interface. 1 3/4" x 1/2" x 1/16" glass epoxy with copper stripped from PCB (RS 276-1591). Center tied to the 3/4" plastic pipe.
H) 9-ft. open wire 1/4-wave stub, #18 wire (solid hookup wire, insulation stripped off (RS 278-1291)). Wires spaced 1 1/2" with glass-epoxy spacers every 12."
I) Stub/cable balun. (See Figure 3 for details.) Connected to stub about 7 ft. 9" from open stub end (adjustable).
J) Shorting bar, about 8 ft. 8in from open stub end (adjustable).
K) Glass epoxy stub tie down.
L) 50-ohm feedline (RG-58U, RS 278-1326).
M) Highest house roof elevation.

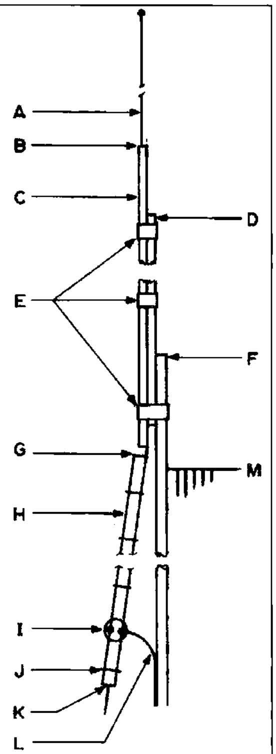


Figure 1. Antenna Schematic.

A) Whip antenna.
B) Whip antenna clamp made from sheet aluminum.
C) 1 1/8" x 1/16" plastic washer,center clearance hole for the whip (foil stripped PBC).
D) 1/4" thick spacer, several layers of plastic tape.
E) 7/8" x 1/16" plastic washer, clearance hole for whip.
F) Plastic tape to prevent the washer from sliding down.
G) 3/4" PVC pipe.
H) 7/8" x 1/16" plastic washer, clearance hole for the whip antenna mounting screw.
I) Washer/soldering lug.
J) Whip antenna hold-down nut.
K) ##18 wire solid hookup (RS 278-1291).

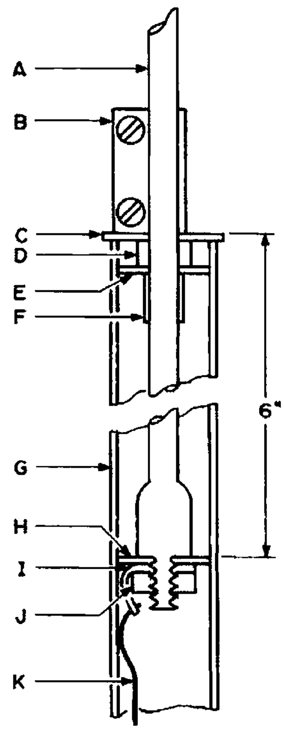


Figure 2. Whip antenna-PVC pipe interface detail.

a bi-filar six-turn coil wound on a 1-1/16" diameter form (3/4" PVC). The wire used is #18 solid hook-up wire (RS 278-1291).

The J Measures Up

Line type performance results from the distributed capacitance between the two wires, making a relatively wide bandpass transformer. Performance was measured using a 50-ohm source together with a 200-ohm resistive load. Although the results indicated the response is less than -0.5 dB at 14 MHz, it falls off much faster at the high frequencies. At 146 MHz, it's about -20 dB (an advantage when working RS-11).

To measure insertion loss, I connected two transformers in series (50-200-200-50-ohm), and measured the response with and without the transformers. The difference was about 0.1 dB. This is trivial when considering radiation loss, but there is still significant thermal (heating) losses while running high power. In the final antenna configuration, with 100 watts into the antenna, element heating is just barely apparent to the touch.

You can double the wattage capability by simply paralleling two transformers.

Correction Factors for Selected Diodes

Vp In	Vp Out	Factor
5.0	4.88	1.02
4.0	3.90	1.03
3.0	2.87	1.04
2.0	1.89	1.06
1.0	0.92	1.09
0.8	0.72	1.11
0.6	0.52	1.15
0.5	0.43	1.16
0.4	0.33	1.21
0.3	0.24	1.25
0.2	0.15	1.33
0.1	0.06	1.67
0.05	0.02	2.5

My tests of this configuration show near identical results at 28 MHz, but the frequency response becomes sharper—about -1 dB—at 14 MHz. When fabricating the transformer, you must hold the wires close together to achieve the desired distributed capacitance between wires. Do this by making the form length the same as the bi-filar coil width, and strapping the two together.

For the strapping I used two pieces of masking tape about 1/4" wide. I wrapped them through the form center and around the wire, then coated the masking tape with an all-purpose adhesive (RS 642307). In forming the coil, first wind the wire on a mandrel smaller than the actual form to make certain the wire has a snug fit when placed on the final form.

Directional Coupler

This antenna, which is essentially an end-fed wire dipole, has a significant Q (about 13). Since the 10m band is so wide (28–29.7 MHz), a high-Q antenna there will give high SWR values at the band edges, so it's important to accurately trim the 1/4-wave stub length (shorting bar position), and adjust the balun connecting position for minimum SWR. You can do this easily by using a simple home-made directional coupler.

The directional coupler detailed in Figure 4 uses glue-down 1/8" wide PCB

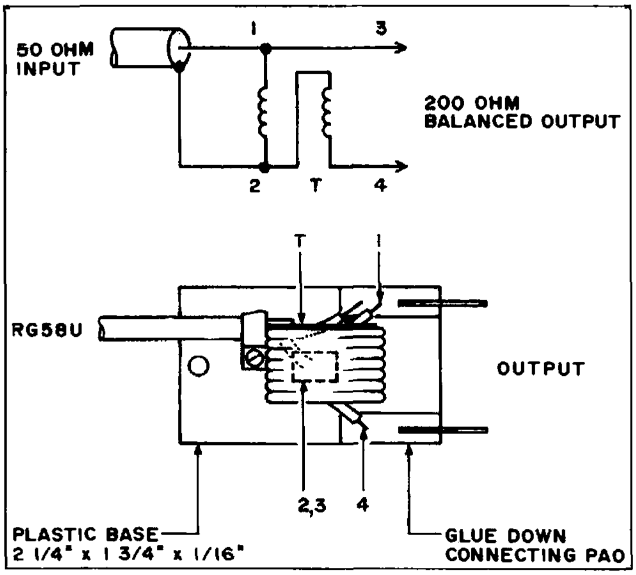


Figure 3. Balun construction details. (The numbers 1–4 and T in the schematic correspond to those in the lower diagram, which shows the balun's physical layout.)

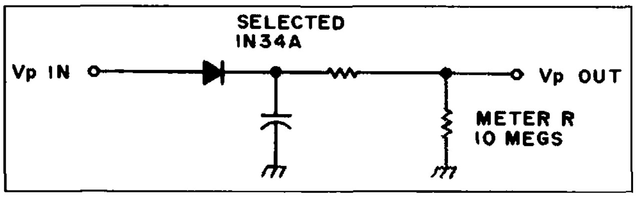
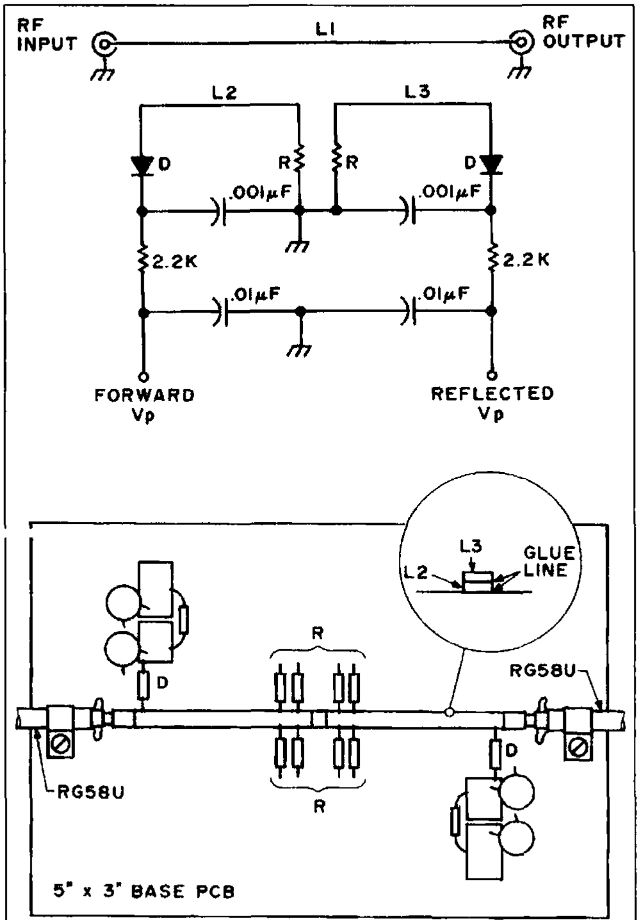


Figure 5. Correction factors for selected diodes, which are those having a reverse resistance of greater than 5 megohms.



D) 1N34A, selected for greater than 5-megohm reverse resistance (RS 276-1123).
L1) 3 1/2" x 1/8" x 1/16" glass epoxy PCB, either single- or double-sided copper (RS 276-1591). Glue to base PCB with adhesive (RS 64-2307).
L2) 1-1/4" x 1/8" x 1/16" glass epoxy PCB, either single- or double-sided copper. Glue to top of L1.
L3) Same as L2; leave about 1/32" spacing between ends of L2 and L3.
R) Select for minimum reflected power. About 36 ohms (100-100-150-1k in parallel).

Figure 4. Directional coupler.

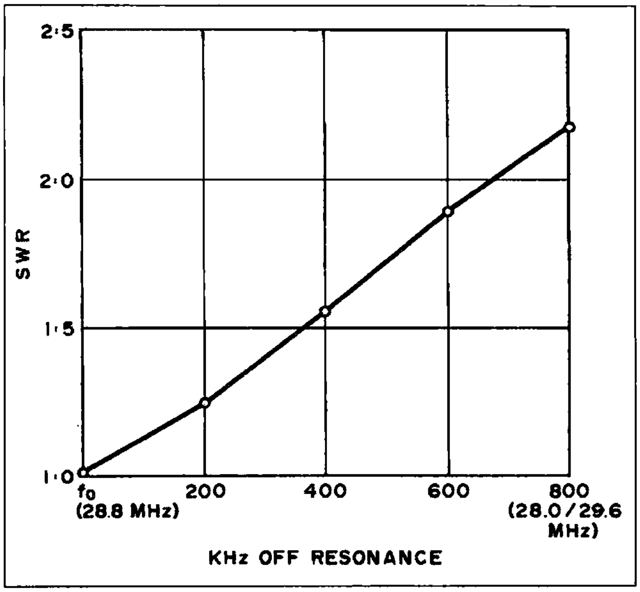


Figure 6. Measured standing wave ratio.

strips. Directional current is detected with short strips glued to the top of a transmission stripline. Resistor terminations on these coupled strips cancel the effective coupled output in one direction. These terminations are trimmed for minimum SWR indication with 20-watt or more input into the directional coupler and loaded with a 50-ohm dummy load. My dummy is 20 1k 1/2-watt resistors in parallel, immersed in a pint of cooking oil.

The termination resistor is actually four 1/4-watt resistors in parallel, which lets you select various resistor values to establish minimum reflection indication. My assembly uses 100-100-150-1k-ohm resistors. This value will be different for different assemblies, depending upon the PC thickness and dielectric constant. When aligned, and with 20-watt input, the coupler output should read about 2 Vp in the forward direction and less than 0.1 Vp in the reflected direction (SWR = V(fwd) + V(ref)/V(fwd) - V(ref)). 1N34A diodes with a reverse resistance of 5 megohm or greater give reliable Vp readings up to less than 0.1. Correction factors for the low voltage readings are indicated in Figure 5. (Since sensitivity is directly proportional to frequency, this directional coupler works well in the VHF/UHF frequency range.)

Alignment is simple when using the directional coupler. Simply slide the shorting bar and the balun connecting position for minimum reflected Vp. The adjustments are rather critical, but it is not too hard to obtain an SWR of less than 1:1. The final measurement results are shown in Figure 6.

Cover More Angles

I compared the vertical antenna performance with that of my horizontal antenna using a coax relay to switch quickly between the two. My horizontal antenna is a center-fed long wire with dominant nodes in specific directions (66 feet long).

The antennas complemented each other very well. As mentioned above, the vertical tended to perform better on low-angle skip; the horizontal on high-angle skip. It was also handy to be able to switch between the two to find a better S/N ratio, depending on whether vertically or horizontally polarized ambient noise dominated.

For little money and a few hours of home-brewing, I improved my DXing considerably! 73

Tuner Helper

An easier (and safer) way to tune your antenna while driving.

by F. Dale Williams K3PUR

You are probably familiar with Tuna Helper and Hamburger Helper to make meal preparation easier; this Tuner Helper is meant to assist you in adjusting the antenna tuner or the matching network (depending on fixed or mobile installation) without using the transmitter. This project originated from my need to be able to tune an all-band, motor-driven mobile antenna while driving, without having to activate the transmitter and tune the antenna matching network while watching the SWR/power meter for the best operating point.

Most modern transceivers either come with built-in antenna tuners or are available as separate units. If your station is blessed with matched antennas for each band, you obviously don't need a tuner. Similarly, if your installation has a separate remote variable matching network at the antenna, an extra antenna tuner not only is unnecessary but also creates havoc in the tune-up process since both ends of the transmission line now have frequency-dependent complex variables. Since the all-band mobile antenna can be tuned to 50 ohms at any HF frequency from the driver's seat by a toggle switch, it doesn't require any additional matching networks. The Tuner Helper radiates an RF signal in one of five bands, from approximately 3.5 to 30 MHz. Since the selected band is continuously swept in frequency from low to high, the only tuning required is to the antenna, or tuner in a single- or multiband antenna installation, while monitoring the strength of the tone demodulated at the selected receiver frequency. Once the antenna or tuner is adjusted to produce the strongest response at the receiver frequency selected, the system has found the best possible match. Then you can power off the Tuner Helper and begin operating without a lot of transmitter tuning steps requiring you to take your eyes off the road while trying different matching combinations and adding another carrier to the ether.

Circuit Description

Figure 1, the schematic diagram of the Tuner Helper, is divided into the sweep generator and swept oscillator sections. Looking at the sweep generator section first, you can see that the requirements are for a linear sawtooth waveform—that is, with constant rise and sharp falloff, from close to zero volts or ground to over 6 volts. Since the MV1404 capacitive diode has a very low ratio of capacitance change to voltage at the high voltage end of the performance curve, a large increase of voltage (that is, 6 to 9 volts) yields a very small increase in frequency, especially in the lower bands. Transistor Q1 acts as a constant current generator, charging capacitor C1 at a rate determined by the value of R1. The high input impedance of U1b insures that the constant current generator is not excessively loaded and

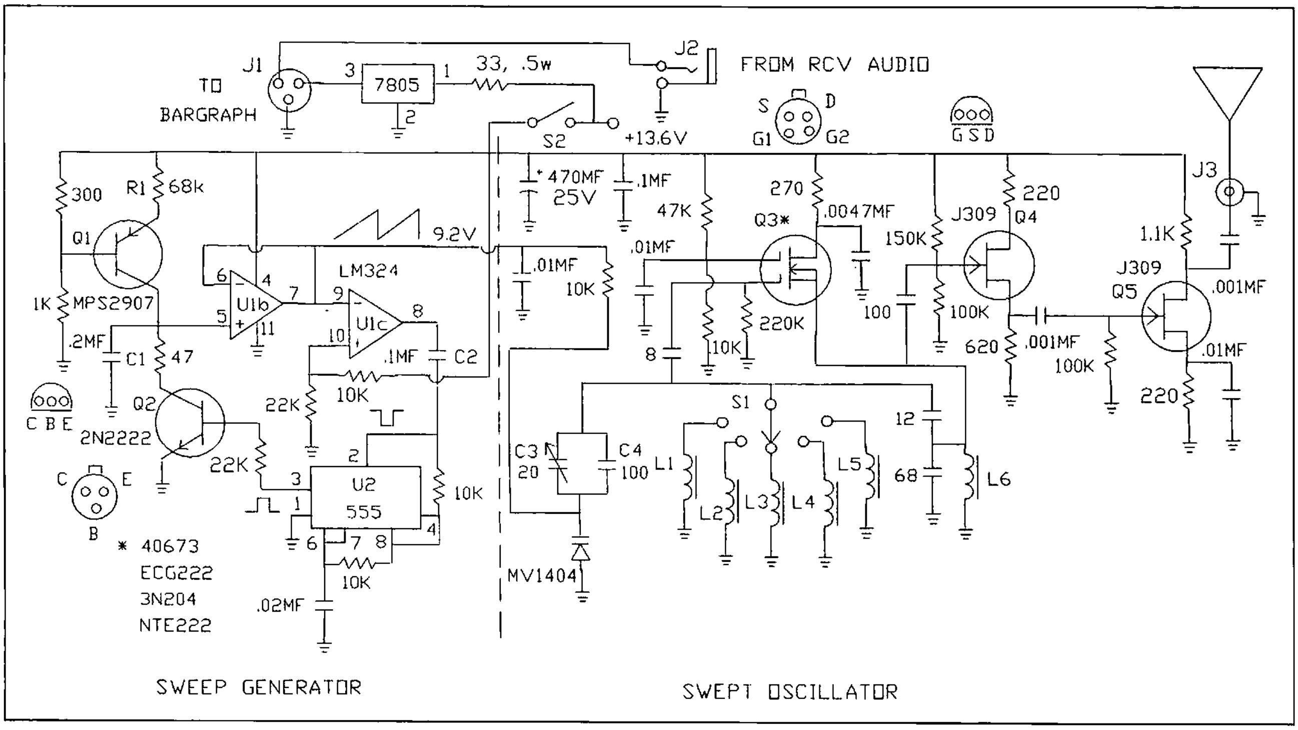


Figure 1. Tuner Helper schematic.

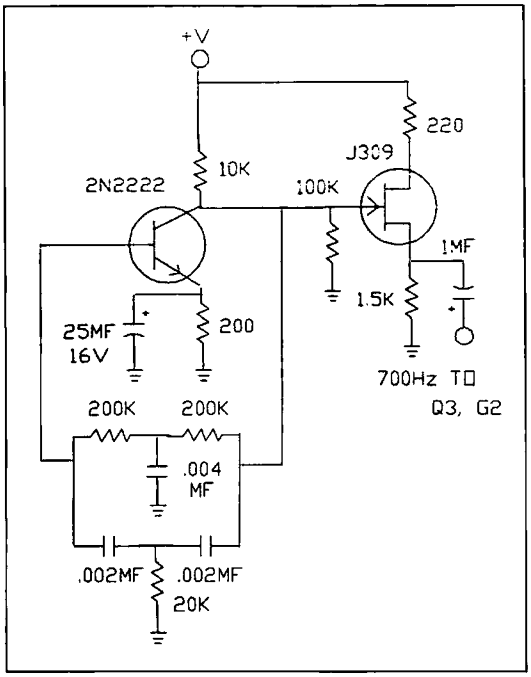


Figure 2. Tone oscillator.

forwards the voltage level of C1 to U1c. Configured as a comparator, U1c output pin 8 goes low when pin 9 rises above 9 volts. This switching action applies a trigger pulse via capacitor C2 to activate the monostable multivibrator U2. The resulting high pulse from pin 3 of U2 provides a discharge path for capacitor C1 through turned-on transistor Q2. A continuous sweep ramp with reset is produced at pin 7 of U1b at a rate determined by R1C1 (approximately 75 Hz).

The swept oscillator section consists of a dual-gate MOSFET transistor in a Colpitts configuration, followed by a buffer amplifier that provides the RF from the selected frequency range to an output amplifier and short antenna. As the output sawtooth waveform from U2, pin 7, is applied to the varactor, the capacitance of the tank circuit decreases from approximately 62 pF at the low end of the ramp to a very low value at the maximum sweep level of about 9.2 volts. The on-off switching action of the sweep waveform modulates the generated RF to produce an obnoxious buzz, which is easy to discern from other low-level signals at the selected receiver frequency when adjusting the tuner or antenna.

Those hams more interested in being able to tune manually to a specific frequency instead of sweeping a band, especially for fixed station operation, may replace the sweep generator section, C3, C4, and the varactor/biasing circuitry. A 50 pF variable capacitor across the tank circuit will allow tuning across each band. Depending on your circuit layout, the 68 pF capacitor may have to be decreased to obtain the necessary tuning range. To maintain the tone capability in the manual tuning version, you may add the twin-T oscillator shown in Figure 2. It provides a 700 Hz audio signal to gate 2 of Q3 for mixing with the generated RF.

Since the human ear can supposedly detect a change in audio level only greater than 3 dB, and a moving vehicle is not akin to an anechoic chamber, I added an additional level indicator, remotely mounted on the dashboard (no looking down at the S-meter). As shown in Figure 3, an LED bar graph and driver are connected to the receiver audio output to provide a visual, as well as audible, indication of received signal level. Since it's mounted in a small enclosure and attached to the dashboard with double-sided or hook-and-eye tape, it's easy to tune the rig without having to look down at the S-meter for the final couple of dBs.

Construction

The Tuner Helper is easily built using a pre-drilled, general-purpose circuit board with solder pads, such as the Radio Shack number 276-158. A suggested layout is shown in Figure 4. To make it more convenient for both construction and testing, the bandswitch S1 was mounted to the circuit board using a small angle bracket made from scrap aluminum. Final installation of S1 should be delayed until the five coils are successfully wound and tested. The five toroid coils are then mounted vertically and secured by silicon cement, directly behind the bandswitch. After the space required for the toroids has been defined, construct the circuit. Begin with the varactor and other components of the tank circuit, and then progress to the oscillator, buffer, and amplifier. Test this part of the circuit with each individual coil by connecting a 10k-ohm, or greater, variable resistor across a voltage source of approximately 10 volts, with the wiper temporarily attached to the sweep end of the varactor biasing resistor. By monitoring the output frequency on a frequency counter or receiver, while adjusting the biasing voltage from about 1.2 to 9.2 volts, you can check each coil for minimum frequency range. Capacitor C3 is set to bring the lowest frequency as close to 3.5 MHz as possible, with the high end reaching 6 MHz on the low band. After the swept oscillator section is completed and tested, you can construct the sweep generator. Test points for voltages and waveforms are noted in the schematic diagram.

There is plenty of room on the circuit board for layout. The size of the board makes it compatible with many small enclosures, such as the Radio Shack number 270-253, or smaller versions available from Ocean State Electronics—(800) 866-6626 (order line), or (401) 596-3080 (information). The antenna consists of a 6-inch piece of #12 or #14 solid wire soldered into an RCA male plug, with a short piece of insula-

Continued on page 18

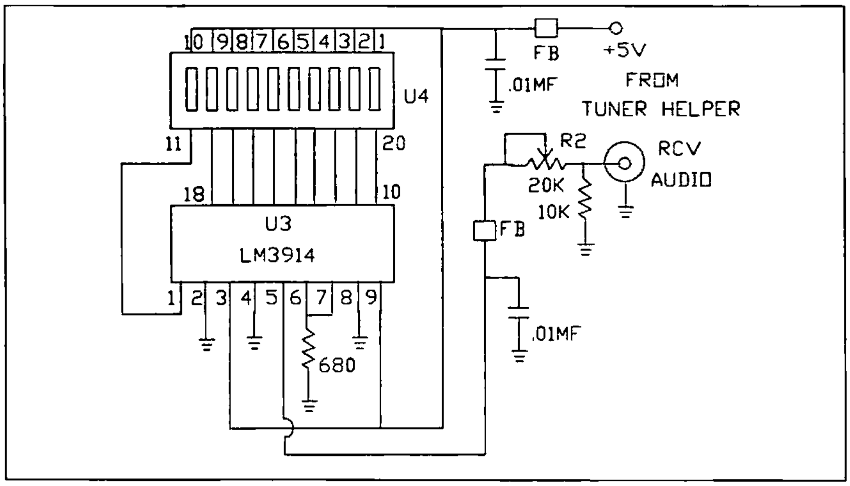


Figure 3. Bar graph schematic.

tion covering the portion where the ground connector of the plug is clamped over the wire. A right-angle bend is then made to the wire at the rear of the connector, after attaching the cover.

I enclosed the bar graph circuitry in a small plastic box that previously held parts. Make an opening for the bar graph display in the middle of the front of the box using a Dremel tool and file. You can then make connection to the Tuner Helper with two-conductor shielded cable, which enters the bar graph box through a rubber grommet on the side so that the cable runs down along the dashboard when the display is mounted vertically. A cable clamp on the circuit board ensures that the cable connections do not twist loose. A Radio Shack board number 276-150 is used for the bar graph circuit construction. Cut the board in half along the outer solder pad number 12, producing two almost square boards. Then these two boards are again cut in the opposite dimension, above the two common solder pad lines, to provide two smaller boards where each chip could be mounted. Solder the bar graph IC to the configuration pads on one board, allowing space on either end for screw holes to be made to attach it, via spacers, to the enclosure through the previously made cutout. Also solder the driver IC to the other board and make connections to the bar graph board, which is placed at a right angle to the driver board, via parallel bus wire. Care must be taken to insure that the two ICs are mounted in a configuration that allows the outputs of one to be parallel to the other's inputs. The remaining connections are then made and the driver board attached to the bottom of the plastic enclosure with double-sided foam strips. Since the enclosure is so small and the display board is attached to the top via screws, no additional attachment is necessary for the bottom board.

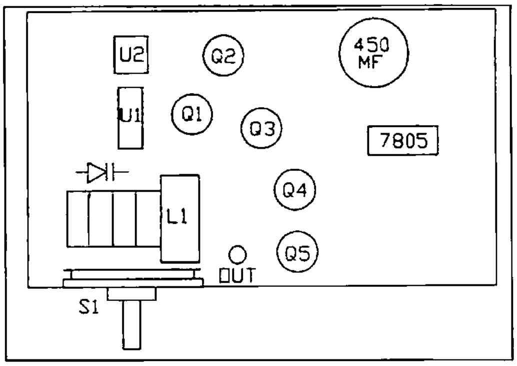


Figure 4. Suggested layout.

Although the audio attenuation resistors are shown on the bar graph schematic, they may be mounted on the main Tuner Helper board, if desired, to save space on the driver board. The trimpot is set by determining which band produces the lowest audio in the installed configuration, and then adjusting the trimmer for about half-scale display on the bar graph. If the strongest band still lights all of the LEDs, then the trimmer can be reset for lower drive level. As shown in the main schematic, the bar graph display is active whether the Tuner Helper is in use or not. If you would rather not have the display react to the receiver audio when not required for tuning, then place the

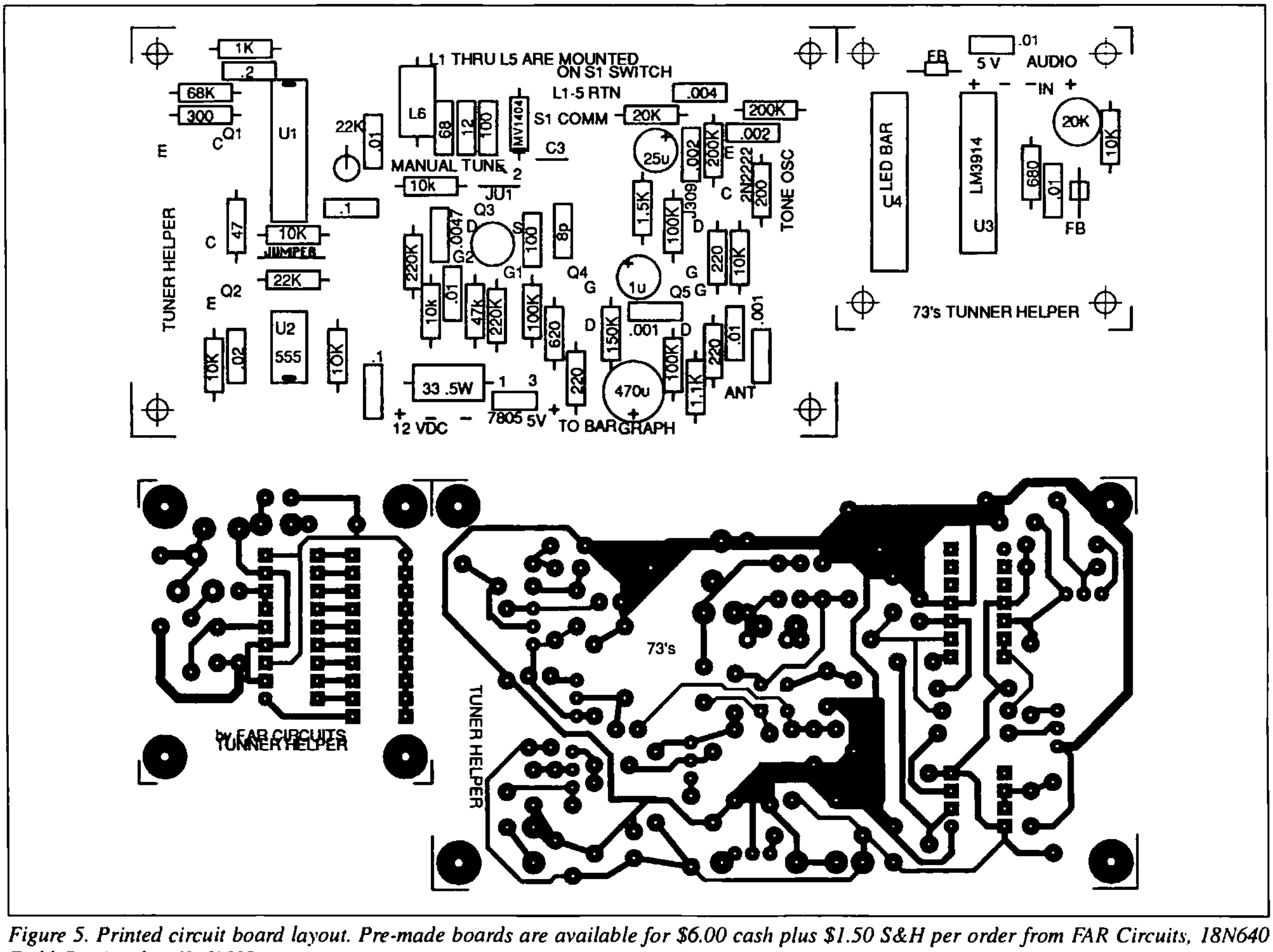


Figure 5. Printed circuit board layout. Pre-made boards are available for $6.00 cash plus $1.50 S&H per order from FAR Circuits, 18N640 Field Ct., Dundee, IL 60118.

voltage supply line to the 5-V regulator dropping resistor on the output side of power switch S2.

Although the Tuner Helper originated to meet a specific need, it has also found use as a signal generator on the test bench for filter design, receiver alignment, and antenna testing.

References

Veronese, Fabio, "Build A 'Gate-Dip' Meter," Popular Electronics, *November 1994.*
Rakes, Charles D., "Circuit Circus," Popular Electronics, *November 1994.*

Parts List

Qty.	Part	Value
1	Resistor	300
1	Resistor	1k
1	Resistor	68k
1	Resistor	47
2	Resistor	22k
1	Resistor	33, 0.5 W
6	Resistor	10k
1	Resistor	47k
1	Resistor	220k
1	Resistor	270
1	Resistor	150k
2	Resistor	100k
1	Resistor	620
2	Resistor	220
1	Resistor	1.1k
1	Resistor	680
1	Trimpot	20k
1	Variable cap	20 pF
1	Mylar cap	0.2 µF
1	Mylar cap	0.1 µF
1	Mylar cap	0.02 µF
1	Silver mica cap	100 pF
1	Ceramic cap	8 pF
1	Ceramic cap	12 pF
1	Ceramic cap	68 pF
1	Ceramic cap	0.0047 µF
1	Ceramic cap	0.1 µF
5	Ceramic cap	0.01 µF
1	Ceramic cap	100 pF
2	Ceramic cap	0.001 µF
1	Electrolytic cap	470 µF, 25 V
2	Ferrite bead	
1	Varicap	MV1404
1	PNP transistor	MPS2907
1	NPN transistor	2N2222
1	Dual-gate MOSFET	40673
2	NFET	J309
1	5V regulator	7805
1	LED driver	LM3914
1	Bar graph display	Radio Shack 276-081
1	J1	P605C jack, T607C plug (Ocean State Electronics)
1	J2	3/8" stereo plug/jack
1	J3	RCA plug/jack
1	Power connector	Radio Shack 274-222
1	S1	Radio Shack 275-1386
1	S2	Radio Shack 275-624
1	Choke	100 µH

Coil Data

L1	3.5-6 MHz	25 µH	T80-6	65T	#28 wire
L2	6-10 MHz	0 µH	T37-6	47T	#30 wire
L3	10-15 MHz	3.6 µH	T37-6	27T	#28 wire
L4	15-22 MHz	1.6 µH	T37-6	18T	#28 wire
L5	22-30 MHz	0.92 µH	T37-6	13T	#28 wire

Just Another Loop Antenna

Or Is It?

by John Sehring WB2EGQ

Just when you start to feel comfortable with an old, familiar antenna which you think you know all about, along comes a new twist. No, this is not just another antenna article. Question: *Would you like to get some directionality on 75 meters (and 160 capability, too) from a familiar antenna, without moving parts or phased arrays?* Then read on!

I've always liked loop antennas. When they're one wavelength or more in length, they can show a bit of gain over a dipole. They are broadbanded, are tolerant of their surroundings, and seem quieter for reception.

About 10 years ago, when I lived in New Jersey, up went about 275 feet of 14-gauge stranded insulated wire in the shape of an inverted delta loop. Its length was calculated from the formula for the driven element of a square (quad) loop: L = 1005/F, where L is the length in feet and F is the frequency, in my case 3.8 MHz. I added about 25 feet of wire "just in case."

The loop was in the shape of an isosceles triangle with the horizontal portion on top, about 45 feet high, and tied between two trees. It looked like an upside-down "delta" and lay wholly in the vertical plane. The plane of the wire ran in the northeast-southwest direction. The bottom end was almost at ground level and came right into the basement shack; so there was practically no feedline, just six feet of extra wires at the ends.

The resonant frequency of the loop turned out to be 3.8 MHz; therefore, the extra 25 feet of wire was necessary. Because my impedance bridge showed the loop's input impedance to be about 165 ohms resistive at resonance, I made up a 4:1 voltage-type balun[1]. The balun transforms the impedance of the antenna downward toward 50 ohms. It also matches the unbalanced coaxial feed to the balanced load of the antenna.

The wire's insulation, while not necessary, does serve three purposes: 1) it keeps RF off of tree branches; 2) due to a velocity factor of about 0.98, it reduces a bit the necessary size of the antenna; and 3) it prevents wire corrosion, which can increase the wire's resistance (especially to RF), thus reducing antenna efficiency[2].

On the air, the loop performed well both transmitting and receiving. Compared to a 130-foot-long, end-fed wire that ran from ground level upward at a 30° angle, it seemed quieter with respect to local QRN and QRM, such as power line noise. During the day, signals from further away were now readable, thanks to reduced noise levels—a definite improvement as the SNR was better.

Surprise!

I discovered an unsuspected facet of the antenna quite by accident. The feed points of the loop were temporarily connected to the balun with alligator clips. One day as I listened to a QSO on 75m, one of the clips popped off. This left only one of the two feed wires of the loop connected and the other dangling.

When that happened, the signal to which I was listening dropped considerably in signal strength but the noise level stayed about the same, indicating that the antenna was still "hearing." Reversing the connections by hooking up the other feed wire of the loop (leaving the first one unconnected) made the signal stronger! Further checking revealed definite directional properties of the loop when it was fed this way. The nulls were quite narrow and deep, and sometimes useful in reducing QRM and QRN. The directionality seemed evident in both azimuth and elevation.

In spite of the interesting directional properties of the loop when fed this way (end-fed with an L-network against ground, like the high impedance end of a long wire), the balanced feed produced stronger signals on both transmit and receive for the kind of casual operation (out to 1,000 miles) that I usually do on 75m. So I left the end-fed arrangement for receive-only use, where signal-to-QRM and/or signal-to-QRN ratio, not just signal strength alone, are important for hearing a desired signal.

DX

Then, during the cooler months came some excellent DX propagation conditions on 75m. Surprisingly, the end-fed configuration was often superior to the balanced feed. It usually elevated DX signals from the northeast direction (for example, Europe from New Jersey) by a few dB or so and, at the same time, suppressed stateside signals and QRN significantly. Curiously, these effects occurred most often when feeding the wire end toward the northeast; here was that directionality again.

Evidently, the end-fed loop had a high elevation angle null in its pattern, tilted away from the end that was being fed. Local signals and noise were suppressed as their high angle of arrival put them right into the null.

What I had found here was an

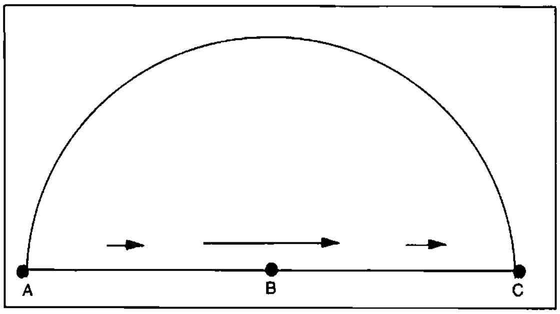


Figure 1. Current distribution of a half-wavelength dipole.

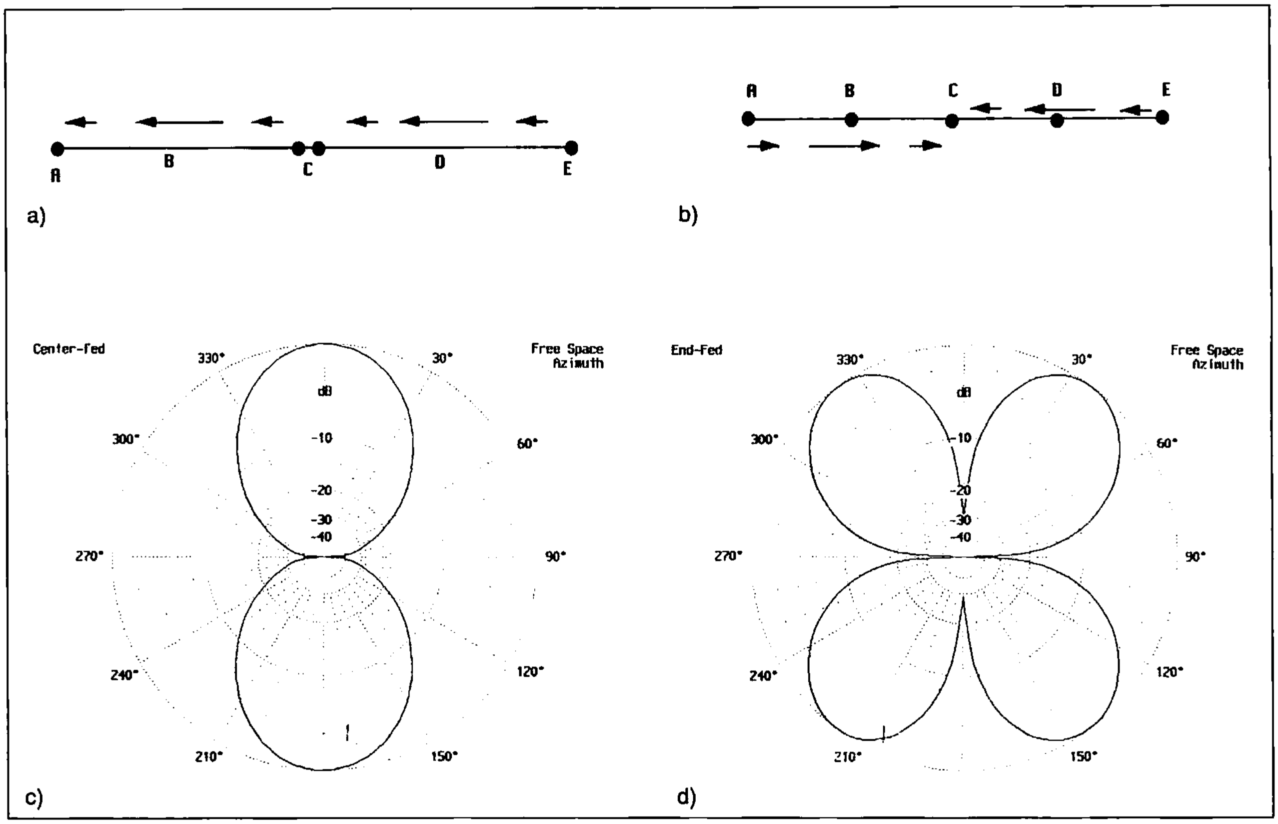


Figure 2. A) current distribution of an end-fed full-wavelength antenna; B) current distribution of a full-wavelength center-fed antenna; C) radiation pattern for a center-fed one-wavelength antenna; D) radiation pattern for an end-fed one-wavelength antenna.

antenna of flexibility, capable of strong high-elevation angle performance for stateside contacts (when balanced-fed) and, at the flip of a switch, improved performance for DX with a low-angle lobe and simultaneous high-angle rejection (when end-fed). An added bonus was the 180° switchable endfire directivity.

No, it cannot compete with a dipole at 150 feet, or phased vertical or parasitic arrays, but the improvement over a typical low dipole or inverted-vee is obvious, and the complexity and cost is minimal.

Some Detective Work

The loop's unusual properties when end-fed caught my interest. To see what was happening, I compared the antenna's current distribution in free space with both balanced- and end-feed, so I could estimate what kind of radiation patterns they would produce. Yes, there are computer programs that analyze antennas, but they are most efficiently used when you have at least a qualitative understanding of how an antenna works. I'll touch on this again.

Half-Wavelength Wire

Figure 1 shows the current distribution of a half-wavelength dipole that is sinusoidal. The dotted lines show the amount of current in various parts of the antenna. The arrows show both the direction of current flow and, by their length, the amount of current flow where they are drawn, like a vector.

The relative amount of current at a point on an antenna can tell us the impedance there. Since impedance equals voltage divided by current ($Z = E/I$), high current indicates a low feedpoint impedance and, conversely, low current indicates a high impedance.

The amount of current in a dipole is highest at its center (point B), giving a low impedance there. We know this to be true, as its impedance when center-fed is usually about 50 to 70 ohms.

At each end of the dipole we have current minimums. It has to be this way because it's the end of the antenna and so current cannot flow to anywhere. The impedance there, at points A and C, is therefore high.

To avoid upsetting the symmetric current distribution of a dipole when center feeding it, we need to use a balanced feed (a coaxial feedline would need a balun). A balanced feedline presents equal but opposite polarity (plus and minus) voltages, so its presence in the center of a dipole would not disturb current distribution there.

Full-Wavelength Wire

Now we'll extend our wire to one full wavelength and draw the current flow again (see Figure 2). If we feed it at the center (point C), we get the current distribution shown in Figure 2A. There are now two current maximums, at points B and D. Current in both halves is forced to run in the same direction (they are in phase) by the feedline. Current is at a minimum in the center and at both ends (points C, A, and E, respectively).

But if we feed this antenna at an end instead of the center, the current distribution will be quite different, as seen in Figure 2B. There are once again two current maximums. But current in the two halves now runs in opposite directions (they are anti-phase). It could be fed at either end, point A or E, which are, once again, high impedance points.

Since it is current flow (its strength and direction) that generates a radiation pattern from an antenna, we expect

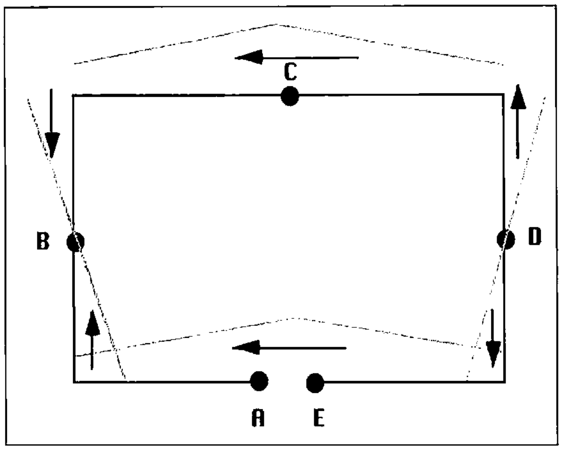


Figure 3. Current distribution of a quad loop.

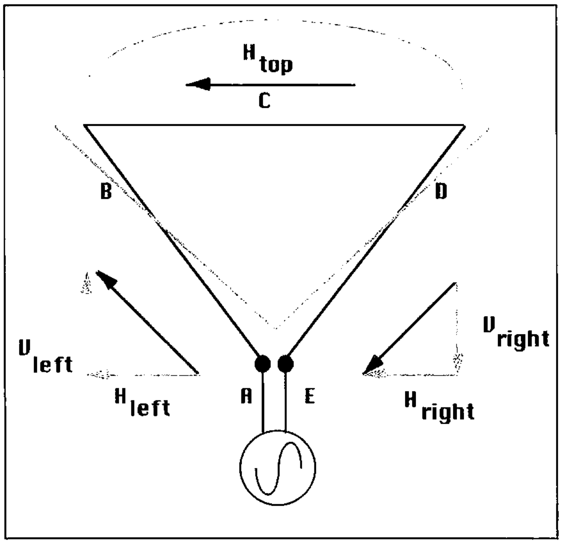


Figure 4. Current distribution of an inverted delta loop, balanced fed.

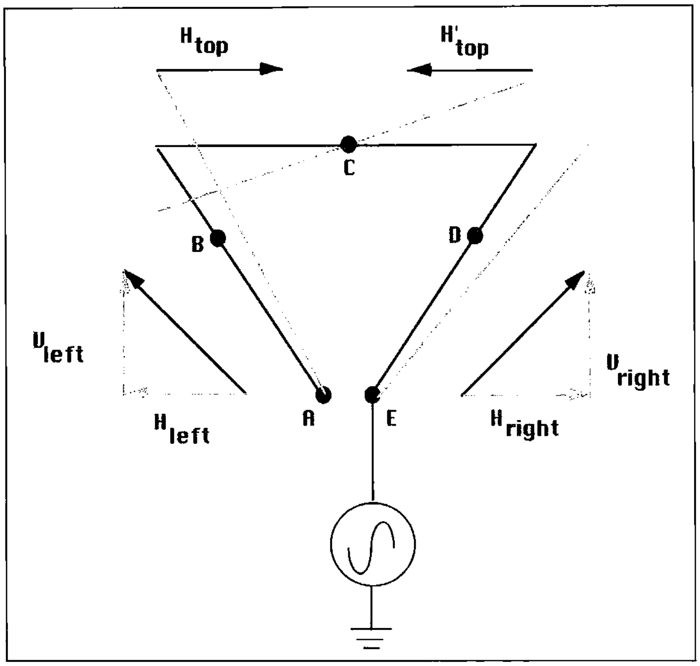


Figure 5. Current distribution of an end-fed full-wavelength loop.

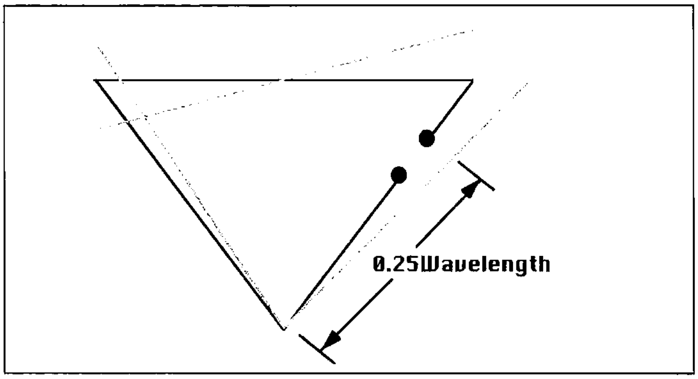


Figure 6. Current distribution of an inverted delta loop, side-fed.

(correctly so) that the directivity will be different when it is fed in these two different ways.

Looking at the end-fed antenna plot from a direction perpendicular to the wire's axis, radiation from the two equal but opposing currents cancels. On the other hand, the center-fed antenna's in-phase currents add up to produce maximum radiation in this same direction. Figures 2C and 2D show this (the plots are for free space patterns; the wire axis runs side to side in both plots).

So, by simply moving the feed point, we can get very different radiation patterns from the same piece of wire.

Balanced-Fed Loop

Let's now draw the current distribution for a balanced-fed inverted delta loop by starting with a quad (square) loop. You can think of a quad loop as two half-wavelength dipoles stacked a quarter wavelength apart, with their ends bent up (and down) to touch each other. See Figure 3.

We know from our experience that the quad loop has a low input impedance, so current must be at a maximum at the center feed point, point A-E (and also at point C opposite the feed point). The quad's upper and lower halves' current distribution does in fact correspond to a pair of dipoles. Compare the current distribution of the top and bottom halves of the quad with the dipole shown in Figure 1: They are the same.

We can now reshape the quad loop, along with its current distribution, into an inverted delta loop shape, shown in Figure 4. To see what's happening, we break the side leg currents into their horizontal and vertical components, H and V. These are shown as Hleft and Vleft for the *horizontal* and *vertical* components on the left leg of the loop, and as Hright and Vright for those on the right leg. The current in the top section, Htop, flows strictly in the horizontal direction (to the left).

The horizontal side currents Hleft and Hright both run in the same direction as the horizontal current Htop in the top portion of the antenna (to the left), so all three add up. Hence we have horizontally polarized broadside radiation from this antenna.

We see that Vleft and Vright go in opposite directions (up and down, respectively). Therefore, these vertical current components cancel each other in a direction broadside to the loop—that is, in and out of the plane of the page—and there is no broadside vertically polarized radiation. (Due to the side leg spacing, there will be some vertically polarized radiation in the endfire directions.)

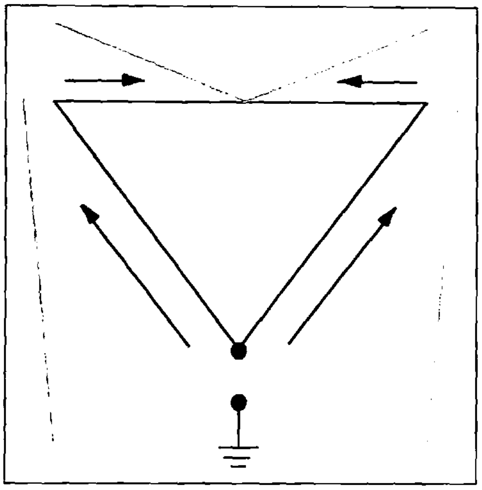


Figure 7. Current distribution of an inverted delta loop, F = 1.9 MHz fed as a vertical element.

End-Fed Loop

Now what about feeding only one of the wires, leaving the other unconnected? Let's fold the one-wavelength, end-fed wire of Figure 2B into an inverted delta shape along with its current distribution (see Figure 5).

We now have high impedance at our feed point as the current maximums have moved to points B and D of Figure 5. This altered current distribution in the loop changes its pattern, just as we saw with the straight wires in Figures 2C and 2D.

In this case, there are two horizontal currents (Htop and H'top) in the top portion that are equal in strength but run in opposite directions and so cancel. The side leg currents, broken again into horizontal and vertical components, show that Hleft and Hright also run in opposite directions and they too cancel. The result is no horizontally polarized radiation.

But the vertical components Vleft and Vright now run in the same direction (up) and so aid each other. Thus, we have vertically polarized broadside radiation from the antenna when it is fed this way.

And depending on the spacing of, and relative phasing of current in, the two side legs, we also have the potential for endfire vertically polarized radiation. But we haven't yet explained the two different endfire directivities noted on the air.

Endfire Directivity

The end-fed loop currents in the side legs should be in phase with each other since the distance from the feed point to the end of the antenna is exactly one wavelength; 360° of phase shift brings you around to 0°, in phase again. If this were actually so, the end-fed loop would have exactly the same pattern in both endfire directions.

But this is not so. We have observed endfire pattern changes when switching feeds from one end to the other. This could occur only if there were an extra amount of phase shift in the currents as they moved along the wire. What can the source of this phase shift be?

Traveling Waves

It is caused by "traveling waves" on the antenna. Non-center-fed antennas display a traveling wave effect. This shows up as an increasing phase shift in the current as we move away from the feed point. It is mostly the result of RF energy being radiated from the antenna. The effect of the traveling wave is to skew the pattern of an antenna, pulling it in the direction of the wire axis away from the end feed point[3, 4, 5].

In the case of our end-fed loop (which, you recall, is a bent, end-fed antenna), it makes the pattern nonsymmetric in the two endfire directions. This shows up as different low-angle gain and a high-elevation angle null that is tilted away from the end being fed.

Side Feed

Another possible feed arrangement for the inverted delta loop is to break it at an upper corner to feed. This is reported to be a good configuration for DX with a strong, low-elevation angle, a vertically polarized lobe, and only a weak high-angle lobe[6].

A further refinement is to feed it below the upper corner, on one side leg, at a distance of a quarter wavelength up from the wire axis at the bottom (see Figure 6)[7]. This side feed location forces the currents in the two bottom legs to reverse direction exactly at the bottom junction and exactly in the middle of the top section, when the loop is operated at resonance.

This gives perfect current symmetry: The vertical components add up and the horizontal components cancel, to the greatest possible extent. This maximizes the strength of the low-elevation angle lobe, while producing the deepest high-angle null.

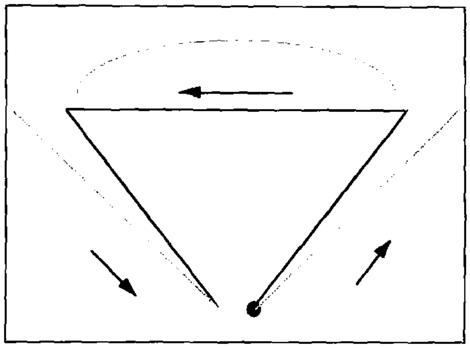


Figure 8. Current distribution of an inverted delta loop, F = 1.8 MHz end-fed.

Surprise Number Two

Drawing the currents of the side-fed loop shown in Figure 6 reveals a startling fact: The current distribution is exactly the same as for our end-fed loop! Compare it with Figure 5.

I had long wanted to try the side feed arrangement, but was daunted by the fact that this configuration would not be optimum for non-DX contacts and that the upper corners of my loop were located in high trees. So there would be no easy, quick way of changing the feed point from bottom to side, and vice versa, to switch modes. End feeding the loop solved these problems and gave switchable endfire directivity, too.

You Mean There's More?

Yes, 160m can also be had with this piece of wire Here's how: If you could grab the middle of the top of the loop and stretch it all the way up, you'd have a quarter-wavelength long, 160m vertical antenna consisting of two parallel wires connected at the top.

So I thought to feed the wire as a "squashed" or wide cage quarter-wavelength long vertical antenna. I did this by tying both bottom ends together and feeding them against ground. The input impedance was about 50 ohms.

Once more we can plot the currents (see Figure 7), remembering that on 160m the wavelength is twice as long as on 80m. Based on an analysis of the current as before, the horizontal components of the current in the sides and top run in opposite directions and so cancel. This leaves only the vertical components of current in the sides running in the same direction (up) and so add together, and we have vertically polarized radiation.

Another ham suggested that I ground one end of the loop and feed the other against ground. This turns it into a conical, vertical, folded unipole (half of a

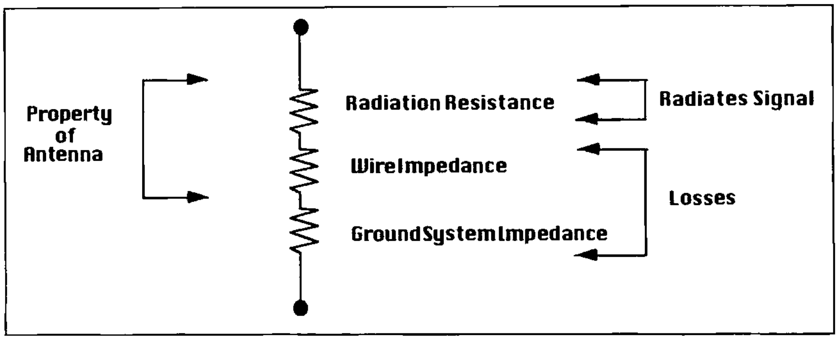


Figure 9. Equivalent circuit of a vertical antenna and ground system.

folded dipole). The feed point impedance is about 75 ohms, which still allows direct coax feed. This configuration works about as well as the squashed vertical feed arrangement above but is sometimes noisier on receive.

Don't kid yourself about improved efficiency here, though. It's just the input impedance of the antenna that's been stepped up by the folded dipole action. Series losses due to ground resistance are still there to the same extent[8].

Let's give that end-fed trick a try on 160 too, again using the L-network and fed against ground. We could be surprised some more; it sometimes worked better than the squashed vertical configuration and occasionally displayed some mild directivity when I swapped feed ends. Looking at the currents (Figure 8) shows that it's a mostly straight-up, horizontally polarized broadside radiator with vertically polarized endfire radiation. This should give a decent combined polarization, omnidirectional pattern.

Ground System

In general, you need a good ground system to get the most out of antennas that produce vertically polarized radiation, as our end-fed and squashed vertical fed loop does.

With a base-fed quarter-wavelength vertical antenna, current flow is maximum at its bottom end, right next to the ground. The amount of ground current that is caused to flow depends on the amount of antenna current flow closest to the ground.

As a result, a large amount of current will flow in the nearby ground around the base of a quarter-wavelength antenna. This leads to highest I2RGROUND losses as the ground currents fight their way, in a radial pattern, back to the base of the antenna through lossy soil, heating up the dirt.

For this kind of antenna to work most efficiently, the ground system must intercept as much of the surrounding ground current as possible and convey it, with the least amount of loss, back to the base of the antenna.

As the ground resistance appears in series with the impedance of the antenna, power applied to the antenna will divide between them depending on the relative impedances. The ground system is therefore very important for good performance in this situation. A good radial or counterpoise (elevated radial) system, plumbing connections, ground rods, and so forth are needed to get the most performance from such antennas.

This shows why we need to think of the combination of antenna and its ground as a system.

160m Ground

On 160m, we're running the squashed vertically fed loop just like a quarter-wavelength vertical antenna (maximum current at the bottom end of the antenna), and so a good ground system is necessary.

Since the measured input impedance of our squashed vertical loop is about 50 ohms resistive at 1.9 MHz, it can be directly fed with coax. The antenna is quite broadbanded on 160m due to 1) its large effective diameter (like a cage antenna), and 2) ground losses.

But both my computer modeling and the *Antenna Engineering Handbook*[9] tell me that the actual impedance (radiation resistance, the useful part that actually radiates a signal) of the antenna, when fed this way, is about 20 ohms rather than the 50 ohms I measured.

This means that the additional 30 ohms is due to a combination of ground resistance (about 28 ohms[10]) and wire impedance (about 2 ohms; this is not DC resistance but the RF impedance of the wire that is higher due to the skin effect—see Reference 1) that show up in series with the radiation resistance of the antenna. Figure 9 shows the equivalent circuit of the system.

This causes inefficiency, about 8 dB worth, which means I'm throwing about 60% of the power away with my particular ground system! A better ground system would reduce this loss and thereby increase antenna efficiency.

Your tip-off here to better performance is that the antenna's measured input impedance will drop toward, but won't quite ever reach, about 20 ohms as the ground system is improved.

75m Ground

When our loop is end-fed on 75m, its current maximums (points B and D in

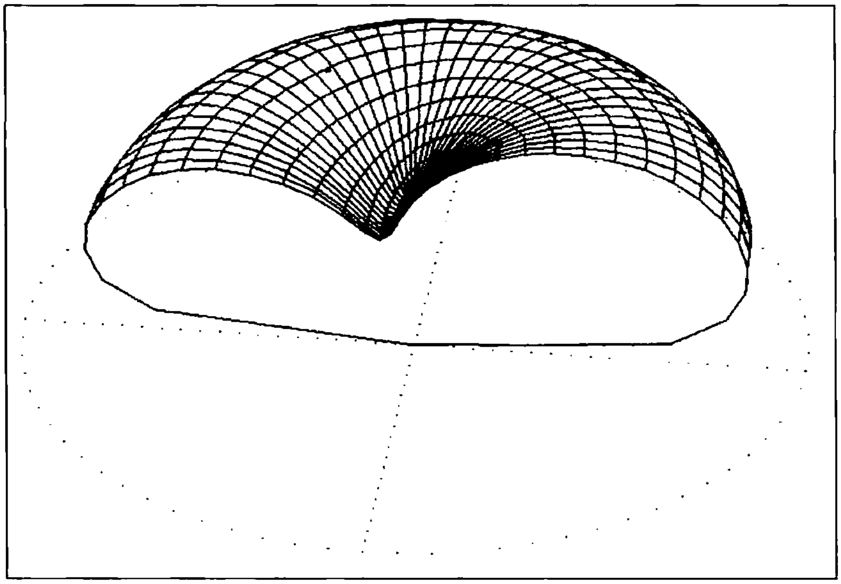


Figure 10. The 3-D plot of the end-fed loop (75 meters), showing the high-angle null in the pattern which is tilted away from the end being-fed, and the low-angle lobe all around.

Figure 5) are raised up off the ground. to a height approaching a quarter wavelength. Recall that it produces vertical polarization when end-fed. Its current distribution is like a half-wavelength vertical antenna, with the current maximum now raised up a quarter wavelength in the air. Rotate the dipole of Figure 1 by 90° and put one end touching the ground to see this.

Because antenna current at the bottom end of the antenna, near the ground, is now minimum, less (lossy) ground current is induced. Also, the feed point impedance is now higher so that relatively less voltage gets developed across the ground system impedance, as in Figure 9. This means that ground system requirements are less stringent for our end-fed loop on 75m than they are on 160 m[11].

Because those parts of the antenna radiating the most (the current maximums) are now raised off the ground, the end-fed loop on 75m shares some of the other advantages of a half-wavelength vertical antenna: 1) A slight lowering the elevation angle of radiation; and 2) Better clearance of nearby obstacles. Overall, there is a reduction of ground, environment, and feed losses, relative to a base-fed quarter-wavelength vertical.

My loop worked satisfactorily with four insulated-wire, quarter-wavelength radials that just lie on the ground. Two radials are cut for 75m and two for 160m. They lie in the plane of (directly beneath) the antenna in both directions. This arrangement of radials gives me maximum measured RF ground current.

Broadcast Band

Since the upper edge of the standard AM broadcast band lies just below 160m, I thought to try the antenna and its feed variations there. I noted different reception effects when changing among the feed types, down to about 1100 kHz though they are strongest toward 1600 kHz.

For example, feeding the antenna as a squashed vertical brought one vertically-polarized 50 kW BC station on 1560 kHz located within ground-wave range well up in signal strength. Switching to end feed suppresses it so greatly (20 to 30 dB) that co-channel skywave-propagated stations never before heard become audible.

On one occasion, switching among balanced, end, and squashed vertical feed allowed three different co-channel stations to be logged. This is an admittedly rare occurrence but illustrates how useful selectable directivity and polarization can be.

SWLing

As the loop shows numerous HF resonances, it's not surprising that it's useful all the way up to the top of the HF spectrum and beyond. Once again, the various feed arrangements are useful in optimizing HF reception. As before, some feeds optimize SNR and some optimize signal strength; they are not always the same!

Since the antenna is so broad and flexible, I believe that construction of the largest loop within the limits of available real estate and supports, regardless of its size (and therefore resonant frequency), would provide an excellent SWL antenna. The L-network could probably be dispensed with for reception, but you'd definitely want to be able to switch easily among various feed arrangements.

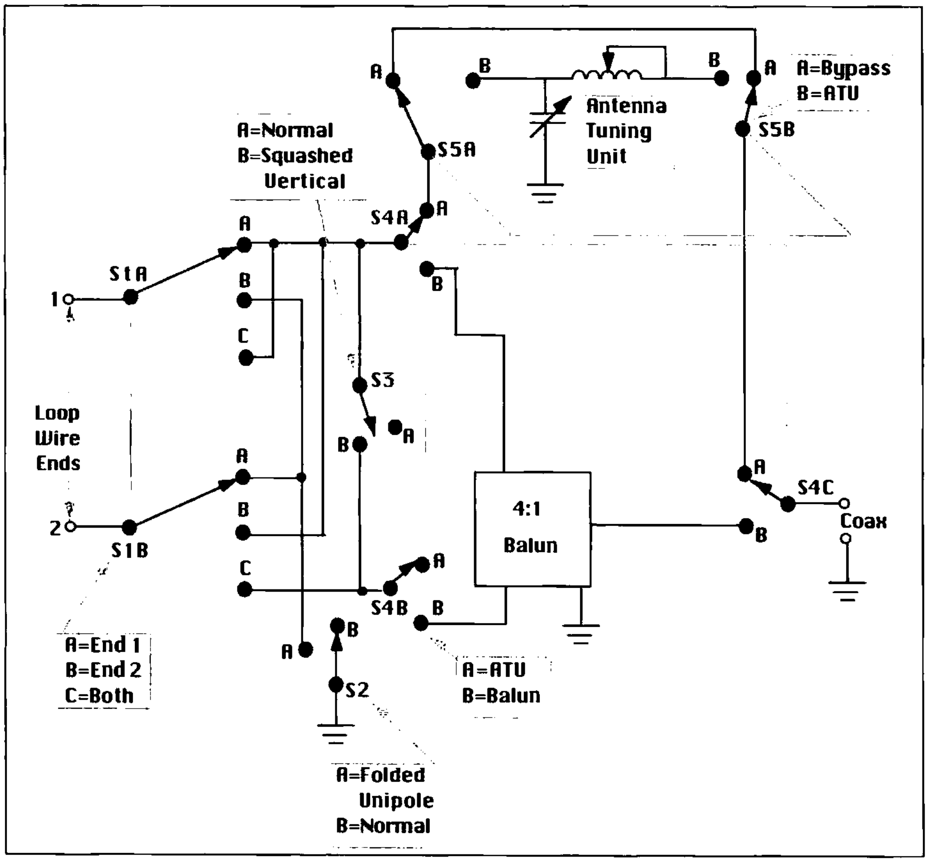


Figure 11. Loop switching and feeding arrangement for convenient selection of all the different feed arrangements described.

Other Bands

The loop also works fine on 40, 20, 15, and 10 meters using the various feed and matching arrangements. I haven't tried it on 30, 17, or 12 meters yet but I'd expect good results there too.

Other Loop Shapes

I think it's worth trying these various feed arrangements with any other loop shape (quad, delta, circular, and so forth) as well, no matter what their height above ground, or length and type of feedline, or whether they are oriented in the vertical or horizontal plane, or anywhere between.

Computer Modeling

After using the antenna for several years, I was able to model it using the MININEC antenna analysis program. MININEC has certain limitations when modeling antennas with horizontal wires, or horizontally flowing currents, less than 0.2 wavelengths off the ground: For example, gain predictions will be too high, but pattern shapes will be reasonably correct[12].

The analysis clearly revealed what I had noticed on the air when end feeding the antenna on 75m. The 3-D plot shown in Figure 10 shows the high-angle null in the pattern that is tilted away from the end being fed, and the low-angle lobe all around.

Summary

This article has described four different ways of feeding an inverted delta loop antenna: 1) balanced feed at bottom; 2) end-fed at bottom (one wire fed and the other wire left floating); interchanging the fed end swaps the endfire directional patterns; 3) one wire-fed and the other wire-grounded, a folded unipole; 4) both bottom end wires tied together, fed against ground, as a squashed vertical.

Figure 11 shows a switching arrangement for convenient selection of all the different feed arrangements. This could also be done with patch cords and alligator clips.

I would enjoy hearing about your experiences with this kind of antenna (Box 373, Baker, MT 59313). Please include an SASE if you'd like a reply.

Epilogue

Since moving to Montana, I have put the antenna up again. Unfortunately, I have just one row of relatively short trees to use for supports, so the loop now lies in a plane tilted about 20° from horizontal. The top of the loop still runs horizontally for about 95 feet, but is only 30 feet high.

The side legs are quite unequal in length. One leg is partly draped over the roof. The lower end of the loop (the feed point) slopes downward. The feed point is about 10 feet above ground. The feedline consists of a parallel run of extra wire that runs into the shack (again in the basement!).

In spite of these handicaps, the loop still shows some directivity effects and can be used in all the ways previously described. When end-fed on 75m, it does not have the low-elevation angle capability of the original arrangement, though. When balanced-fed, it's more of a "cloud warmer" but is still quite satisfactory. It seems to have better performance on 40m than before.

On 160, it's now electrically too long for resonance at 1.9 MHz, so I use a three-gang AM broadcast receiver-type variable capacitor in series with it to tune out the inductive reactance. When fed against a decent ground, its input impedance approaches 50 ohms resistive.

It works surprisingly well on 160 meters for such a low antenna; its top is only about 0.12 wavelength off the ground on 160m. However, soil conductivity is quite high here due to a large amount of dissolved alkaline minerals. This would enhance the performance of the antenna considerably.

References

1. The ARRL Handbook, *American Radio Relay League, 1983, p. 19.7. Plans for a balun can be found in almost any amateur radio handbook. Orr, W. I.*

2. Radio Handbook *(21st Ed.), Editors and Engineers Div. of Howard W. Sams, Indianapolis, 1978, p. 3.18. As frequency is raised, more and more of the current is forced to flow in the outer layers of a conductor toward its surface. This means that corrosion of antenna wires or elements, which occurs on the surface, can have a stronger effect on antenna losses because more of the RF current flows there. Insulated or coated, wire and elements can prevent corrosion.*

3. *Rautio, J.C., "The Effect of Real Ground on Antennas—Part 5,"* QST, *November 1984, Figures 4H-4L, 5.*

4. The ARRL Antenna Book, *American Radio Relay League, 1974, p. 58, Figures 2-70.*

5. *Balanis, C.A.,* Antenna Theory, *Harper-Row, New York, 1982, pp. 372-374. Additional traveling wave effects are caused by wire impedance and ground effects.*

6. *Mayhead, L. V., "Loop Aerials Close to the Ground,"* Radio Communications, *May 1974, Figures 9, 15. Gives experimental results from measuring scale-model, variously shaped and fed, one-wavelength loops over a metallic ground.*

7. *Devoldere, J.,* Low-Band DXing, *ARRL, 1987, p. 11-49, Figure 2.55(C). I adapted his feed idea for a delta loop for use with an inverted delta loop.*

8. *Devoldere, p. 11-25, par. 2.4.4.*

9. *Jasik, H., ed.,* Antenna Engineering Handbook *(1st edition), McGraw-Hill, New York, 1961, Figures 3-13.*

10. *Devoldere, op. cit., p. 11-24, Table 12, "Equivalent Series Resistance of Radial Systems in Ohms." See entry for two quarter-wavelength radials.*

11. *Belrose, J. S., "160-meter Antennas," Technical Correspondence,* QST, *July 1991, p. 49-50.*

12. *Lewallen, R., "MININEC: The Other Edge of The Sword,"* QST, *February 1991, pp. 18-22. There is also a well-known frequency offset error in this program for which I have accounted in my analysis. This article gives a good overview of the program.*

Number 7 on your Feedback card

A Discone Antenna for 10 Meters

It looks like a bird cage, but works like a yagi.

by O.B. Boddie W1ZB/6

A truncated cone antenna is a superior radiator, equaled by none. The cone antenna is used extensively on VHF and UHF, and the Skelton cone is a version of it for HF.

The discone antenna described in this article resembles the old cage antenna of the spark days. My XYL says it looks like a bird cage. But, looks can be deceiving. This small antenna was tested extensively, with a 6-dB gain three-element yagi as a standard. It proved equal to the yagi in every way.

This discone antenna has a gain of 6 dB across the entire 10 meter band. How does it do this? It has an infinite number of half waves in parallel for a radiation pattern. It always has the right angle of radiation because of the rotating field pattern.

"This is fine for apartment dwellers and works well from the inside of the apartment because of the multi-angle radiation pattern."

You can build it as a single cone 5 feet high to sit on the roof, giving you a 3-dB gain in all directions at a low angle. This is fine for apartment dwellers and works well from the inside of the apartment because of the multi-angle radiation pattern. It is easy to construct and the cost is so low that anyone can afford to build it. Or, you can construct two cones separately and hang them both from the ceiling or under the eaves on a house or garage. Mine are hung in the shape of an inverted "V" and favor signals broadside. Mounted vertically, it radiates in all directions with a 3-dB gain when using only a 5-foot antenna.

The low angle of radiation makes this cone an excellent DX antenna. It even picked up a few new countries I could not raise on the yagi! For 20 meters, double all measurements and you can have a 6-dB gain antenna on 14 MHz.

If you are using a single cone antenna, no tuner is necessary. On the discone antenna, however, an antenna tuner may be necessary for a perfect match.

Construction Details

These details are for a single cone. Make two of them for a discone.

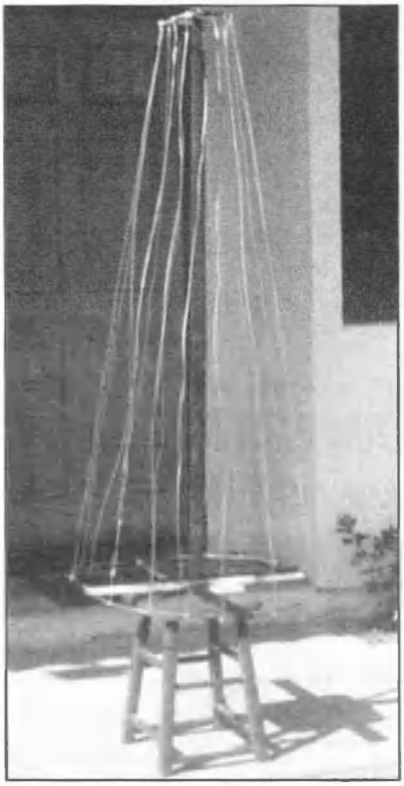


Photo A. Finished discone antenna.

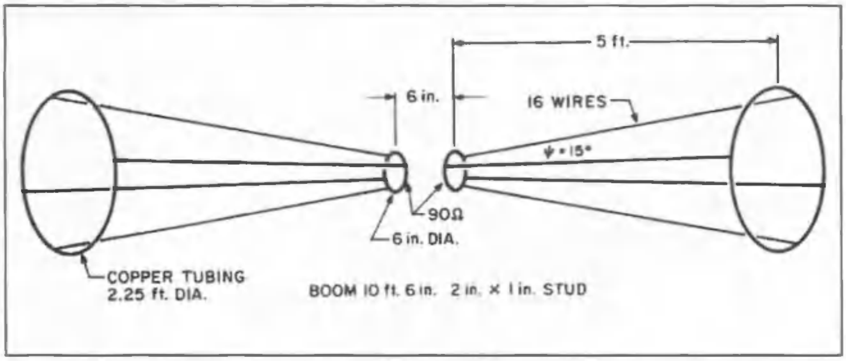


Figure 1. Discone for 10 meters.

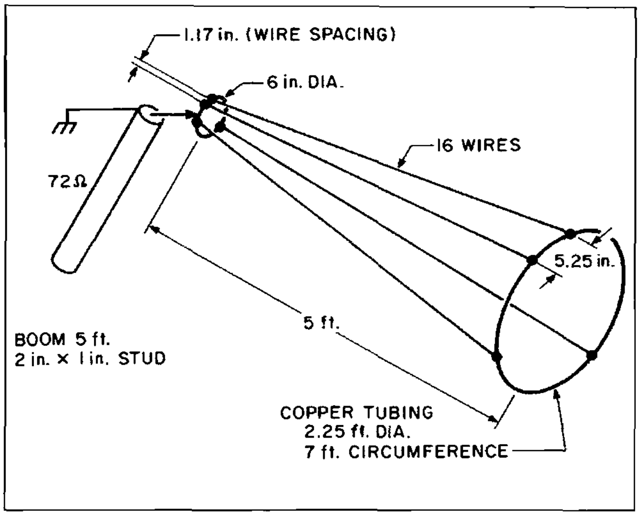


Figure 2. A 10 meter conical.

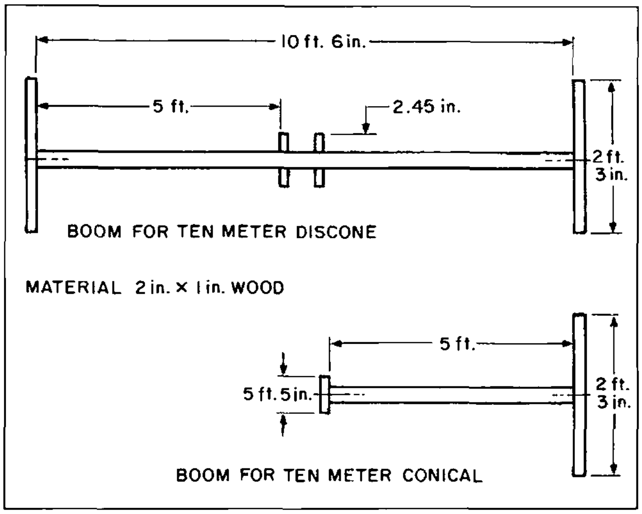


Figure 3. Boom for conicals.

First, make the booms, following the details in Figure 1. Next, cut a 7.20-foot piece of copper tubing. Flatten one inch on the ends with a hammer. Bend it in a circle. Drill through the flattened ends with a #18 drill clearance for an 8-32 machine screw.

Cut off a 20-inch piece of copper tubing. Flatten 1 inch on the ends with a hammer. Bend this piece of tubing in a 6-inch circle. Drill through the flattened ends with a #18 drill clearance for an 8-32 machine screw.

Bolt together the two copper tubing circles with 8-32 machine screws.

It is easy to construct and the cost is so low that anyone can afford to build it.

Insert the tubing circles onto the boom for fit. Shave down the wood for fit. Flatten the copper tubing where it goes over the 2-inch by 1-inch ends of wood.

On both the large and small loops, drill two holes through the copper at the flat portion to clear 5/8-inch by 8-inch wood screws. Remove the copper tubing loops and drill 1/16-inch holes, evenly spaced, in 16 places on each copper tubing loop.

Assemble boom and copper tubing loops together. Tighten the wood screws to hold the assembly together. String 16 wires as per Figure 4 after scraping enamel off the ends of wire for good contact.

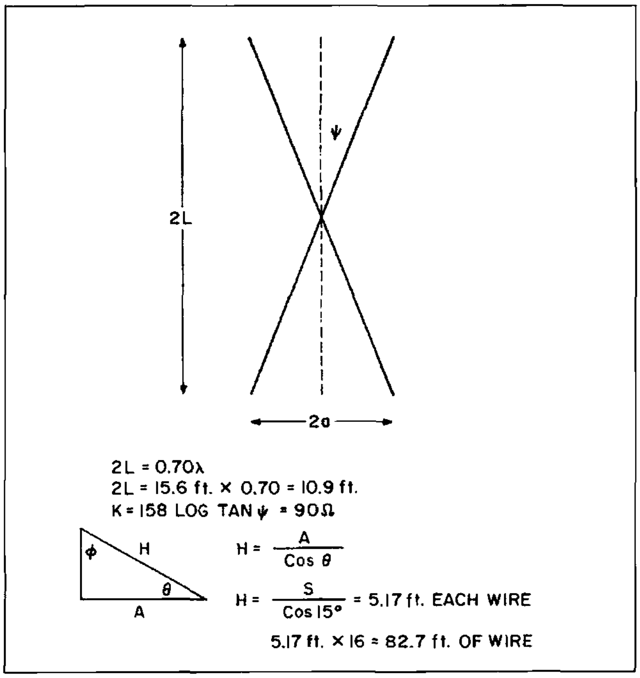


Figure 4. Conical math.

Parts List (for one cone; double for discone)

10 feet of 1/4 inch copper tubing
100 feet of #18 copper wire enamel covered
32 each 3/8 inch #6 pan head sheet metal screws
2 each 1 1/2 inch #8 flat head Phillips brass wood screws
2 each 8-32 1/4 inch-long machine screws and nuts
1 five-foot 2 inch x 1 inch wood stud for boom
1 two-foot-3-inch 2 inch x 1 inch wood for end piece
1 six-inch 2 inch x 1 inch wood for end piece
Note. For the discone, two cones make the boom 10 ft. 6 inches long.

Construction

1. Make booms as per drawing.
2. Cut off a 7-foot 3-inch piece of copper tubing. Flatten 1 inch on ends with hammer. Bend it in a circle.
3. Drill through flattened ends with a #18 drill clearance for an 8-32 machine screw.
4. Cut off a 20-inch piece of copper tubing. Flatten 1 inch on ends with hammer. Bend it in a 6-inch circle.
5. Drill through flattened ends with a #18 drill clearance for an 8-32 machine screw.
6. Bolt together copper tubing circles with 8-32 machine screws.
7. Insert copper tubing circles on to the boom for fit. Shave down wood for fit. flatten copper tubing where it goes over 2 inch x 1 inch ends of wood.
8. Drill two holes through copper at flat portion to clear 1 1/2 inch x 8 wood screws.
9. Do this for large and small loops of copper tubing.
10. Remove copper tubing loops and drill 1/16 inch holes in 16 places on each copper tubing boom evenly spaced.
11. Assemble boom and copper tubing loops together. Screw down wood screws to hold assembly together.
12. String 16 wires as per drawing after scraping enamel off the ends of wires for good contact.

Check Your SWR Bridge!

Think you have a good bridge? Find out for sure.

by W. Paul Wing K1WVX

You should check your SWR (Standing Wave Ratio) bridge, rather than assume that you have a good one. Good-quality SWR bridges that have been left in the line have usually been overranged a number of times. Many inexpensive bridges have poor accuracy. Most SWR bridge construction articles only provide instructions for checking at an SWR of 1:1. This one-point check, which is made by using a standard 50-ohm dummy load, is inadequate.

I will describe how to use resistances in conjunction with your 50-ohm dummy load to check your bridge at several test points.

Resistances to Use

The easiest way to check your bridge at an additional point is to borrow a friend's 50-ohm dummy load and connect it in parallel with your own. You can make this connection with a coaxial tee and a short length of coaxial cable, as shown in Photo A. The resulting 25-ohm dummy load will produce an SWR of 2:1. The reason for this is that the SWR is equal to the ratio between the line impedance and the load resistance, which is 50/25 = 2.0. When necessary, this ratio is inverted in order always to produce a ratio greater than 1. This subject is more fully covered in *The ARRL Antenna Book*. If you cannot borrow a second dummy load, you can easily make one for use at reduced power. The construction of the unit will be covered in a subsequent paragraph.

Also, if you make a 25-ohm dummy load having two connectors, it can be used in series with your 50-ohm load to produce an SWR of 1.5:1, and it can be used in parallel to produce an SWR of 3.0:1. If both "add-on" dummy loads are provided, SWR values of 1.5, 2.0, and 3.0 can be checked, in addition to the usual 1.0 SWR check.

Reduced Power Dummy Load

The main difficulty with building dummy loads is that noninductive resistors are not generally available with power ratings above two watts. In order to avoid using 50 of these for each load, I chose to use a smaller number of 2-watt resistors in combination with my 50-ohm dummy load, and also to use reduced power. A transmitter output power of 35 watts was selected in order to substantially reduce the number of resistors required. Almost all solid state and tube-type transmitters can be reduced to the 35-watt output level by using the front panel controls. Remember that this is approximately equal to 70 watts of input power. Some SWR bridges are not sensitive enough to get readings on 75 and 80 meters with reduced power. In this case, the testing is limited to 10 through 40 meters.

"The main difficulty with building dummy loads is that noninductive resistors are not generally available with power ratings above two watts."

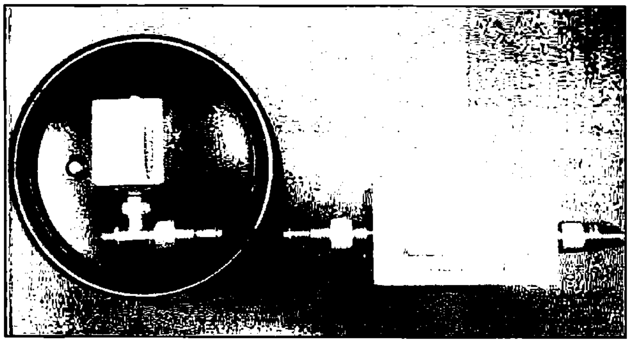


Photo A. A conventional 50-ohm dummy load, connected in parallel with an "add-on" load. The feedline is connected at the coaxial tee.

Accuracy

Two-watt resistors with tolerances of 2%, 5%, and 10% are usually available in radio parts stores. I used 2% resistors because they are not very expensive, and improve the overall accuracy. My conventional 50-ohm dummy load measures 47 ohms. This is an error of 6%. When this is used with an "add-on" load having an accuracy of 2%, the maximum errors range between 3.4% and 4.7%, depending on which test is being performed. This accuracy is considered adequate by most amateurs.

If you wish greater accuracy, you can build and substitute an additional 50-ohm load with 2% resistors. This will result in a complete 2% system. The power rating will remain at 35 watts.

Construction

I will describe first the construction of the 25-ohm unit. It uses twelve 300-ohm resistors in parallel. The schematic is shown in Figure 1, and the completed unit is shown in Photo B. I used Radio Shack perfboard No. 276-1396A. It is 1/16" thick and has holes spaced 0.10" x

SWR Bridge	Test	Actual SWR			
	Freq. (MHz)	1.0	1.5	2.0	3.0
Bridge A	28.4	1.05	1.4	1.8	2.6 .
	7.25	1.05	1.05	2.2	3.2
Bridge B	28.4	1.3	1.3	2.4	3.1
	7.25	1.15	1.1	2.0	3.1
Bridge C	28.4	1.1	1.4	2.7	Approx. 4.0
	7.25	1.05	1.1	2.2	Approx. 4.0

Table 1. Test results for the three inexpensive SWR bridges.

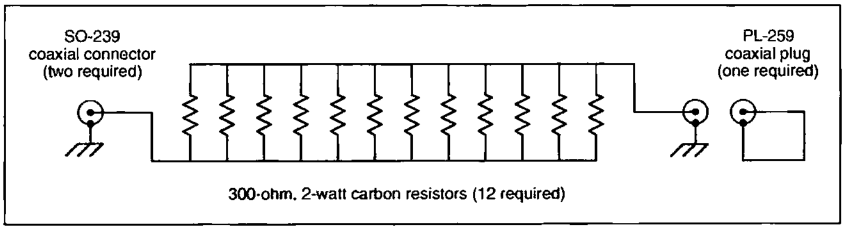


Figure 1. Schematic for the 25-ohm "add-on" load and grounding

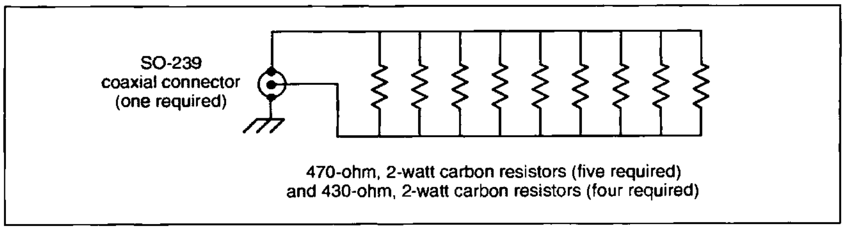


Figure 2. Schematic for the 50-ohm "add-on" load.

0.10" apart. Cut a piece of this perfboard 1-7/8" x 3-1/16" so that it has 18 holes along the short side and 30 holes along the long side. Drill two 1/8" diameter mounting holes at diagonally opposite corners, as shown in Photo B. These holes are located 7/32" from both edges of the board. Also cut five pieces of perfboard 1/2" x 2-5/16" long. These will be used as spacers during soldering. Bend both leads of the twelve resistors 90 degrees so that they will fit through holes in the perfboard that are 0.90" apart. Stack three spacers on the board and hold them in place with masking tape. Install six resistors on top of the spacers with their leads going through holes in the board. The resistors are spaced 0.40". from each other. Hold the resistors in place with masking tape.

Cut two pieces of No. 14 AWG copper wire 4" long. Solder one of these wires to the six resistor leads, as shown in Photo B. The wire is positioned 1/8" above the board by using the two remaining spacers. Turn the board around and repeat this process to solder the other #14 wire.

Stack the two spacers on top of the lower row of resistors and fasten with tape. Install the six top row resistors and solder their leads to both wires. Cut the lead lengths of the two end resistors to measure 9/16" below the board. Bend these four leads through holes 0.3" toward the centerline of the board so as to secure the resistor assembly to the board. Cut off the leads of the other 10 resistors flush with the bottom of the board. Remove all spacers and masking tape.

The enclosure is a Bud-Minibox No. CU-2103-B, which measures 2-1/4" x 2-1/4" x 4". Cut the center holes for the two SO-239 coaxial connectors at the center of each end of the box. Drill two screw holes for fastening each connector on the same horizontal centerline. Remove enough paint where the connectors mount to be sure of good electrical contact. Drill eight 3/16" diameter holes in the enclosure to provide ventilation. The two mounting brackets for the board are made from No. 5 solder lugs. Use a piece of #14 copper wire to solder each pair of lugs together as, shown in Photo B. Bend the brackets 90°, as shown. Attach the connectors and brackets with 4-40 x 1/4" long screws and nuts.

Bend the two #14 leads and trim their ends, as shown in Photo B. Bend the mounting brackets to keep them away from the resistor leads. Attach the board with 4-40 x 1/4" long screws and nuts. Solder the #14 wires to the coaxial connectors, and then install the enclosure cover. Check the resistance between the connector center conductors to be sure that the resistance is close to 25 ohms. Also check the resistance between the connector shells to be

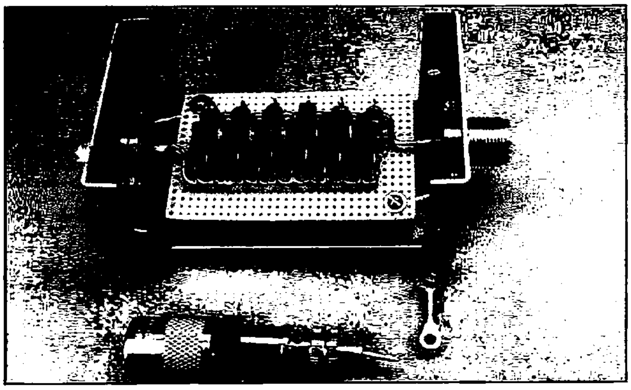


Photo B. The 25-ohm dummy load is shown with its cover removed. The grounding plug and one perfboard mounting bracket are shown in the foreground.

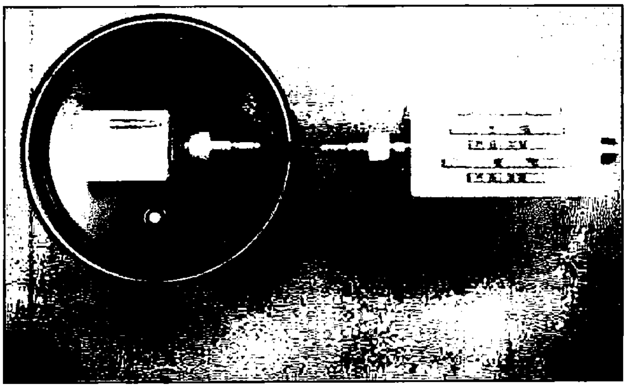


Photo C. A conventional 50-ohm dummy load, connected in series with an "add-on" load.

sure that it is close to zero.

The grounding plug is made by soldering a short piece of #14 wire between the center conductor and shell of a PL-259 coaxial plug. This is shown in Photo B before it was soldered and trimmed. Check the resistance between the center conductor and shell to be sure that it is close to zero. The schematic for the 50-ohm dummy load is shown in Figure 2. It has five 470-ohm resistors and four 430-ohm resistors in parallel. It does not have a second SO-239 connector, or a grounding plug. Otherwise, its construction is the same as the 25-ohm unit.

Testing

Use a relatively short length of coaxial cable between your SWR bridge and the dummy load. Bypass all other items that may now be between them. Adjust the transmitter output power to approximately 35 watts. Discontinue transmitting. Install one of the "add-on" dummy loads and proceed with testing. Photo A shows the parallel connection, and Photo C shows the series connection. Don't forget to use the grounding plug with the parallel connection. It can be attached to either end of the 25-ohm dummy load.

Test Results

The test results for three inexpensive SWR bridges are shown in Table 1. The accuracy of these bridges was not as good as had been expected. Whenever poor accuracy was evident, the test setup was checked to be sure that the resistance was the correct value, and that a good ground connection existed. The SWR meters were also checked to be sure that they zeroed properly, and that they did not have broken jewels. Since many precautions were taken, I believe that the test results are valid, and that these bridges would perform as indicated when used normally in a ham station.

"Since many precautions were taken, I believe that the test results are valid, and that these bridges would perform as indicated when used normally in a ham station."

Conclusion

The test results show that many inexpensive SWR bridges have poor accuracy. You should check your bridge rather than assume that it is accurate.

You can check one additional point by simply borrowing another dummy load, build either one or two "add-on" loads or a complete 2% system. The choice is yours.

When you contact our advertisers, be sure to tell them you saw their ad in *73*.

Number 9 on your Feedback card

Longwave-Plus DX Techniques

Exploring the undervalued lower frequencies.

by Richard Q. Marris G2BZQ

The LF spectrum below 500 kHz is where wireless communications originated, but for many years has remained neglected by the enthusiast in favor of HF, VHF, and UHF. With the advent of so much commercial equipment for these bands, many enthusiastic experimenters have been taking a growing interest in the lower frequencies (LF, VLF, ELF) where there is a mass of interesting activity. For example, take a look at the longwave band (148.5 kHz to 283.5 kHz or 2020 to 1058 meters). For convenience, add the no man's land between the MW and LW bands (525 to 283 kHz) and, for the purpose of this article, we will call the total the longwave-plus band, which then covers 148.5 kHz (2020 meters to 525 kHz.

In Europe, N. Africa, the Middle East, and right into Asian Russia, there are AM broadcast stations. Worldwide there are numerous aeronautical/marine beacons and stations, information stations, CW traffic stations, and so forth. In North America, there is the 160–190 kHz amateur band. In the UK, there are moves to introduce an amateur band somewhere in the LF/VLF ranges.

My renewed interest in the lower frequencies commenced in the 1970s while G2BZQ/WØ in Minnesota. Having an all-band German marine portable receiver, I kept a check on the longwave band. I heard many nonbroadcast stations and beacons, which in England would often be obliterated by high-power AM broadcast stations located eastwards in Russia and south through Europe into North Africa and Turkey. Every Europea country appears to pump out longwa AM broadcasts right around the clock

I was staying in Connecticut wl Hurricane Bella roared northwards r Atlantic City, crossed the end of Lo Island, and came across the Connecticu coast during the late evening. Hurricanes very seldom occur in England and are very tiny compared with the American variety. The Holiday Inn room was on the top floor (!), and a pitch was found, down below, at the end of the bar, where the progress of Bella could be seen on a nearby TV screen. A sporadic listening watch, with headphones, was kept on the marine portable, and I noticed that the longwave band was being seriously affected. When the "eye" of Bella was overhead, the BBC on 198 kHz suddenly appeared with rapidly increasing signal strength until it peaked at full volume. It equally rapidly disappeared as the eye moved on. Why? No answer has been offered. The antenna was a long, fat, built-in ferrite rod/coil.

Since that time, some 20 years ago, I have monitored from 150 kHz to around 525 kHz. Back in Minnesota, I made a 40" x 40" multiturn box loop and kept a sporadic watch during the long winter nights. AM BC stations were occasionally heard from Europe, plus a mass of the usual beacons and other stations throughout North America. The band abounds with activity, and what you receive depends on where you are located, the prevailing conditions, and the time of day and time of year.

To get the best from this longwave-plus band you will do best with a directional antenna and a receiver with AM, CW, USB, LSB, optional AVC, and noise limiter facilities.

The Antenna

The type of antenna used depends on the space available, but must be directional. Three simple types are described below. All are simple, easy to construct and comparatively low cost. In all cases the actual antenna is described, and the method of mounting is left to the individual. The golden rule is to use nonmetallic materials for rod/coil supports and in enclosing the variable capacitor. Also, ideally, the tuning capacitor should be mounted below the antenna with its metal body clear of the wire turns.

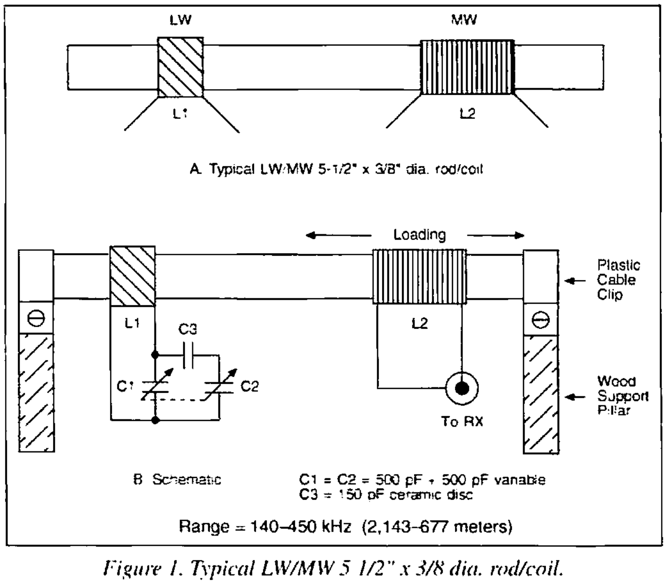


Figure 1. Typical LW/MW 5 1/2" x 3/8 dia. rod/coil.

The "Simplex" Longwave-Plus Antenna

The frequency range of this antenna is 140 kHz to 450 kHz. Its heart is a MW/LW ferrite rod antenna as used in transistor radios, and can be purchased

from suppliers, or salvaged from an old transistor radio. The rod used was 5 1/2" long by 3/8" dia. (see Figure 1A), with LW (L1) and MW (L2) windings. The typical inductances were LW = 4.7 mH and MW = 370 μH. As these coils are moved towards the rod center, the inductance goes up; and when removed to the rod ends the inductance goes down. This feature is used to establish the required antenna frequency range.

The schematic (Figure 1B) shows the LW/MW rod/coil arrangement. The LW winding (L1) is moved towards the end, and the MW winding (L2) is now used for antenna coupling, to the receiver, by moving it along the rod for best coupling/matching—it can then be held in position with a spot of hot candle wax.

L1 is resonated with a 2 gang x 500 pF variable capacitor C1/C2 wired in parallel with C3 (150 pF) in series with C2. On the prototype the frequency range was 140 kHz to 450 kHz, which can be adjusted, to personal requirements, by altering the value of C3, e.g. a salvaged coil may well be a different length and diameter from the one used. The rod/coil can be plastic cable clipped to two 3/8" x 3/8" vertical hardwood, or plastic, pillars, as shown, fastened to a baseplate, with C1/C2 underneath the rod/coil.

The "Simplex" antenna will prove very effective with any receiver.

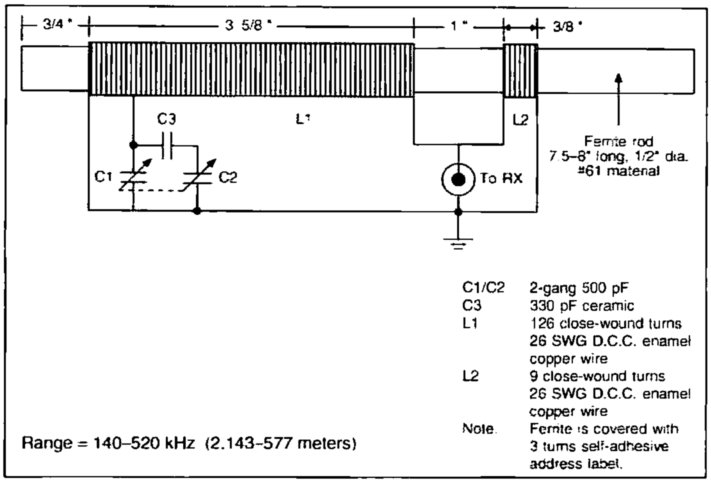


Figure 2. "The Super Ferriter"

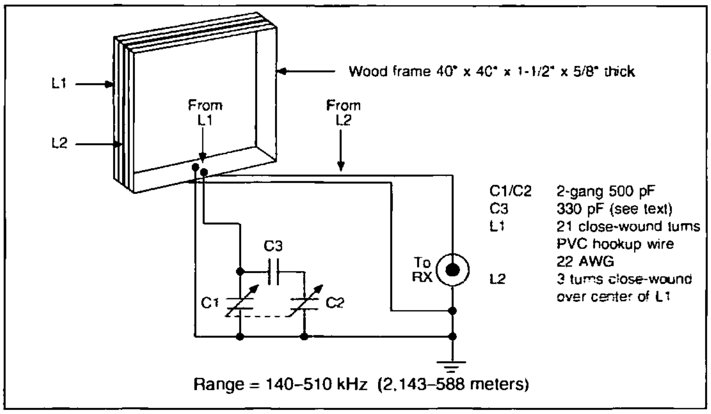


Figure 3. "The Box Loop"

Parts Lists

The "Simplex"

C1/C2	2 gang x 500 pF variable capacitor.
L1/L2	Transistor radio type ferrite rod (MW/LW) antenna, 5 1/2" x 3/8" diameter on prototype from Maplin Electronics type LB12N or similar. Or MW/LW rod/coil salvaged from old MW/LW radio. (Maplin Electronics address: P.O. Box 3, Rayleigh, Essex SS6 8LR England.)
C3	150 pF ceramic (see text).

The "Super-Ferriter"

C1/C2	2 gang x 500 pF variable capacitor
C3	330 pF ceramic.
L1/L2	#26 SWG DCC enamel copper wire—2 ounce reel
Ferrite rod	7 1/2" long x 1/2" diameter type R61—050- 750 OR 8" x 1/2" diameter rod fabricated from two R61—050—400 4" rods glued end to end (see text). (Amidon Associates Inc., 2216 East Gladwick Street, Dominiquez Hills CA 90220. USA).

The "Box Loop"

C1/C2	2 gang x 500 pF variable capacitors.
C3	330 pF ceramic.
Wire	PVC covered Hook-Up wire (22 AWG).

The "Super-Ferriter" Antenna

This personal favorite is a convenient small DX antenna with a frequency range of 140—520 kHz. The schematic (Figure 2) shows a high grade 7 1/2"-long x 1/2" diameter type 61 material Amidon rod. Alternatively an 8"-long 61 material rod can be fabricated from two 4" x 1/2" diameter rods stuck end-to-end with Superglue or quick setting epoxy adhesive. The rod is first covered with three layers of self-adhesive white address labels.

Two windings are shown (L1 & L2). L1 is series tuned with a combination of C1 C2 C3. L2 is the impedance matching/coupling coil giving 50 ohms matching to the receiver input. The coil windings use 26 SWG DCC Enamel Copper Wire (DCC = double cotton covered). The cotton covering effectively spaces the wire turns. The tuning and coupling circuit used give maximum RF signal output voltage to the receiver, and the "Super Ferriter" produces results normally associated with a much larger wire antenna, but with a much lower noise level—QRN & QRM.

The "Box Loop"

This Loop (Figure 3) requires a lot more domestic space than the "Super-Ferriter." The frequency range is 140 kHz to 510 kHz.

A simple wood frame is made of four lengths of 40" long x 1 1/2" wide x 5/8" thick seasoned timber. The whole is glued together as shown. Strengthening blocks can be glued inside each corner.

The main winding (L1) is 21 close-wound turns of PVC covered hook-up wire (22 AWG) around the outside of the frame. Two layers of masking tape should be wound over the center of L1. the coupling winding L2 consists of three turns of PVC covered wire close-wound over the center of L1, over the masking tape turns. L1 is tuned with C1 in parallel with C3 in series with C2. The ends of the coupling winding L2 are taken to a coaxial socket.

Operation

The above three antennas should be connected to the receiver antenna input, with a length of coaxial feed-line, which should be as short as possible. The antennas should be kept clear of the electric supply wiring and metal objects. All are directional, and should be rotated towards the received station for maximum signal and interference elimination. A simple turntable is an advantage to assist with loop rotation.

73 Review

Number 10 on your Feedback card

by Steve Katz WB2WIK/6

Icom America, Inc.
2380 116th Ave. NE
Bellevue, WA 9800
(206) 454-8155
Price class:$2060

The Icom IC-738 HF Transceiver

A sturdy and popular rig.

I'm lucky enough to be frequently offered new equipment for review, and my luck was running well in early April when *73* arranged to have a new IC-738 delivered to me for this purpose.

The IC-738 has been on the market long enough that it's already popular, as is its more pricey sibling, the IC-736. There are only two differences between these units: The IC-736 offers 6 meter (as well as HF band) coverage and has a built-in AC power supply, while the IC-738 lacks 6 meter coverage and requires an external source of 13.8 VDC power. The two rigs share a common owner's manual and most other features. Because the IC-738 lacks an internal power supply, it weighs less (19 lbs) than the IC-736 (23.1 lbs) and may be easier to handle for field operations. As far as I can tell, the IC-736 has no provision for external DC power at all, making it a base station rig in every sense.

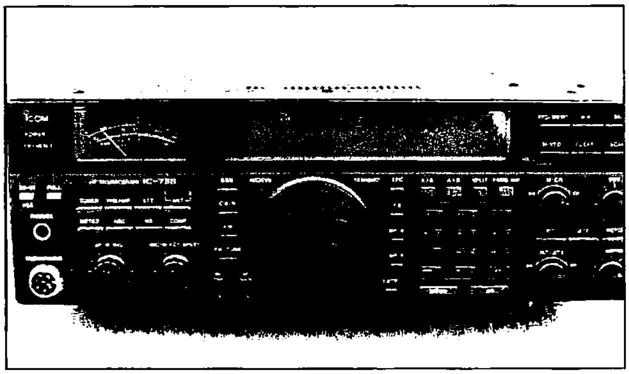


Photo A. The IC-738 has a clean, uncluttered front panel that's user-friendly with a huge main display.

Despite the 738's lighter weight and potential battery-power operation, it, too, is really a base station radio because it is not small. Measuring 13" x 4.4" x 11.2" (H x W x D), the IC-738 has the look and feel of a real radio. Most of its controls are large and spaced far enough apart for even clumsy fingers, and its display is large enough to be viewed from across a large room. The Icom's 59 panel-mounted controls are easy to use, with the possible exceptions of the RF-gain and power output controls.

The IC-738 comes well-packed and includes most items needed to get on the air quickly, save for power supply and antenna. Its instruction manual is reasonably complete and well written. The transmitter output power is rated at 100 watts SSB, CW, and FM, without any note regarding possible derating requirements for high-duty-cycle operation (like FM or RTTY). I don't know whether Icom would consider it safe to operate at 100-W output continuously or not. Also, the specifications discuss only SSB, CW, FM, and AM, and don't mention the digital modes except for brief connection instructions on page 16 of the manual, which state, "The transceiver does not have an FSK mode for RTTY, AMTOR, packet, etc.; however, you can operate these using AFSK in the SSB or FM mode." I'm neither a Digital Demon nor a Binary Bimbo, but even so, I'd expect more discussion of such a popular subject.

Strengths

A point in its favor, though, is that the IC-738 passed my "Can I use this radio without opening the manual?" test with flying colors. I had the rig out of the box and on the air and completed my first 50 or so contacts, without ever glancing at the manual. And that's good. This is important because, in an emergency, there may be no time to indoctrinate operators; they need to sit in front of the radio and use it immediately. The more intuitive the rig is to operate without instructions, the better its design, as far as I'm concerned. On a scale of 1 to 10, I'd give the IC-738 a "9" for intuitive use. I'd have given it a "10," except its built-in, two-port antenna switch (front-panel controllable) kept switching to the unused port as I switched bands, making me scratch my head about why signals seemed so weak on bands where I knew they should be strong! (The IC-738 remembers which antenna position was last used on each band, and reverts to it. As it comes from the factory, who knows how it will be set up? You can override this feature, but it is not intuitive and probably requires an instruction reference.)

The first thing I noticed about the IC-738 was how uncluttered its display is. On power-up, the display panel indicates VFO frequency, mode, tuner status, VFO selection (A or B), and channel number for memory operation. That's it! I like the tidy display, and only wish it omitted the channel number unless memory operation is actually in use. It would then display only what the operator absolutely has to know. The frequency indicator numerals are large (1/2" high) and very easy to read, being dark gray segments against a bright orange background. The display is readable even operating outdoors on a sunny day.

The second thing I noticed is how quiet the receiver is. Unless the PREAMP is activated, the noise level on every band tends to indicate about "S0" (no reading) and the ambient hiss between signals is very slight. This tempts one to turn the volume up very high, to hear *something*. Then, when you tune across a signal, the sound jumps out at you from the rig's top-mounted speaker. The background noise is so low that you wonder if the receiver has the sensitivity we've come to expect from modem equipment. It does. The IC-738 tests as sensitive as any receiver I've come across. The small amount of hiss is due to advancements in synthesizer, IF, and audio stage design. The rig is deceiving. It doesn't *sound* sensitive until you need it to be, and then it's right in there with the best of them.

Weaknesses

Within a few QSOs made, I was able to find a few shortcomings with the Icom—not in performance, but in creature comforts. For example, the analog meter indicates only one of three possible data on transmit: either power output (watts scale), SWR (1 to infinity, with SWR = 3 at center scale), or ALC activity (thick "normal" range). However, there is no

way to tell which scale is active. There is no three-position panel-mounted switch to which to refer. The meter is switched by a single push-button, which toggles the meter mode between the three possibilities.

Another example is the power level control, which, like the receiver RF-gain control, is a small knobless shaft protruding through the front panel to the lower left of the main VFO tuning knob. While I don't find myself adjusting RF gain much, I do frequently like to change transmitter output power. This is a control that gets a real workout in my station, as I've never been an "AKTR" (All Knobs To Right) operator. If I work somebody very strong, I tend almost automatically to reduce my power. If the station worked is very weak, I almost automatically turn it back up. Rapid-fire contesting notwithstanding, I adjust this control a lot, and know many others who do, too. The IC-738's control for this function is too small to be easily and repeatedly adjusted.

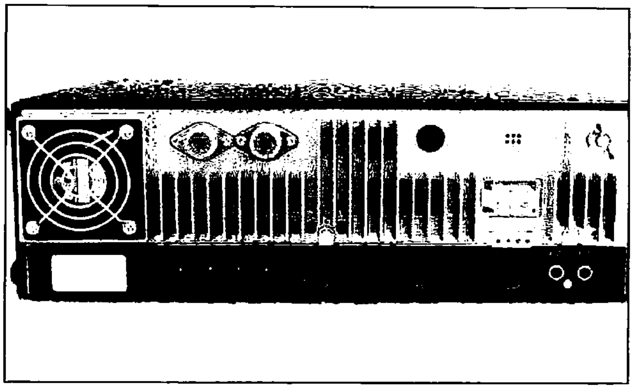


Photo B. Rear View of the IC-738. The two side-by-side SO-239 coaxial receptacles are for two antenna connections. The cooling fan to the left side of the photo is one of two cooling fans used to keep the unit loafing along even at continuous duty at full power.

One other thing that struck me as inconvenient is the placement of the VOX controls, which are on the rear panel. It is inconvenient to have to reach around behind the rig to make adjustments. In many shacks, it might take quite a bit of effort, and maybe a flashlight, to do so! VOX controls, especially the DELAY control, need to be more accessible.

My last gripe is that the IC-738 lacks transmitter mike gain. The factory-supplied, hand-held mike is quite good and sounds fine on the air, but has rather low output level and requires the 738's gain control to be run literally all the way up to make the ALC work properly.

The only other complaints I might have is that the CW sidetone level adjustment is internal and requires removing the covers. The rig has any CW offset you might want by using the ΔTx control (similar to a receive RIT, but works the transmitter offset), but the sidetone pitch always remains the same. As a true CW operator, I like being able to adjust everything I can when using this mode.

Okay, enough gripes. Other than these small issues, the IC-738 works really great!

Strengths again!

If you're already familiar with modern HF gear, you won't need any training in how to use the Icom. If this is your first modem HF transceiver, read the manual and try out each function one at a time. I like that the 738 has two key input jacks, one of them three-circuit for connection of a paddle to use the rig's (standard) internal electronic keyer, and a separate two-circuit jack for use with a straight key, "bug," extemal keyer, or computer control. I also like the rig's use of a common RCA "phono" jack for connecting the key line to an extemal linear amplifier. (Note: This jack is labeled SEND, which is a bit misleading. It is connected in common with pins on ACC[1] and ACC[2], the two accessory DIN-jacks, and is a dual-function I/O port. If grounded, as with a footswitch, the rig will transmit. If connected to the key jack of most amplifiers, it will ground on transmit and cause the amplifier to key.) I happen to *like* RCA phono plugs and jacks, mostly because they've been around for generations, are likely to be in nearly everyone's junk box, and can be picked up inexpensively at a local Radio Shack in a pinch. DINs are fine, but are also the kind of thing you might forget to bring to a DXpedition; DINs are also difficult to assemble in the field.

Operating

My first 30 or 40 QSOs with the new IC-738 were on CW, my favorite mode. (I can hear the boos and hisses, but to each his own.) The rig had no trouble producing more than 100-W output on every band. The semi-QSK worked great and so did the full-QSK (break-in) mode, up to at least 45 wpm.

On SSB, the stock microphone lacks punch unless the mike gain is turned fully clockwise. I'll guess that Icom might have a fix for that by now. I did try using one of my favorite desk mikes, an old American-made Shure 444 (big and clunky, but they usually sound good), and it produced far more punch than the stock hand-held mike and reports received were excellent. With the 444, I was able to turn the mike gain down about halfway and still have sufficient audio to get an ALC indication. The IC-738 has a built-in speech processor whose function is labeled COMP (compression) on the front panel. Its adjustment is also labeled COMP and is located on the rear apron of the radio, next to the VOX controls. The compressor worked pretty well, although stations contacted advised my audio sounded more natural with it off. This is a pretty subjective issue, and I'm used to getting mixed reports about speech processors and compressors. Despite most stations' reports telling me I sounded better with it off, the compressor did its job of increasing PEP output power as indicated on my Autek WM-1 PEP computing wattmeter. This is all one can ask for from a simple speech compressor circuit.

The rig's IF bandwidth, stated as 2.1 kHz (-6 dB), is very adequate for SSB work, but might be too wide for crowded CW operation. I liked the way the receiver sounded with the factory-equipped filter on SSB. It was tight enough to prevent much adjacent-channel interference, but wide enough to allow excellent fidelity of received signals. I thought it was just about the proper balance, and the receiver is one of the best I've ever listened to. Although I have four modern HF rigs, my standards of comparison for HF receiver performance are older equipment that in many ways outperform the latest gear. I use a 1978-vintage Drake TR-7 (transceiver) and a 1958-vintage Collins 75A4 (receiver). Believe it or not, these old-timers offer better performance under some conditions than anything built since. If a modern synthesized transceiver can hold its own against these two radios, I'm usually astounded. The IC-738 comes very close.

The IC-738 is one of the few modem HF rigs I've used having a receiver that I like listening to on SSB. I did not have at my disposal the optional narrow CW filters on the review model, so I can't comment on them. But the standard SSB filter works very well, and the optional filters are plug-in, not solder-in (although installation does require removing the radio's covers).

The 738's standard, built-in ATU (automatic antenna tuning unit) is fast and smooth as silk. I was extremely impressed with it. The ATU is activated and then implemented with a single push-button control (TUNER). A fast push activates it, and a longer push engages the tuner, which makes the transmitter operate at reduced power until the tuner finds a nearly perfect match point. I could not find any point in any band where I could not achieve a nearly perfect match with the antennas I normally use. I could even get my 6 meter vertical to load up on 80 meters, as well as achieving success with my 160 meter dipole on every single band, including 10 meters.

As an experiment, I tried loading up a 12" long Radio Shack clip lead (#20-gauge wire with an alligator clip on each end) on 20 meters. I clipped the far end of the lead to a paper poster hanging on the wall (a contest award, actually!) and the rig found a match within a few seconds. I answered a strong W5 in Arkansas, and completed a contact with the clip-lead antenna. I should note that my shack is at ground level, enclosed within the house and having no windows to the outside. This is not a very objective test, and I have no way to measure the impedance of the clip lead on 14 MHz, but it goes a long way in demonstrating the effectiveness of this tuner.

The ATU obviously has memories, and seems to know how to retune itself (once set

points have been established by prior use) as the receiver is being tuned across each band. The problem is that I don't know how many tuner memories it actually has, because the manual does not address this point. The ATU also retunes itself to the presets as one tunes around on the receiver, which makes transmitting at full power on nearly any frequency as easy as pressing the PTT button or key; but the manual does not discuss this point, either. This is a shortcoming of the manual: The rig has features that work very well but aren't even mentioned!

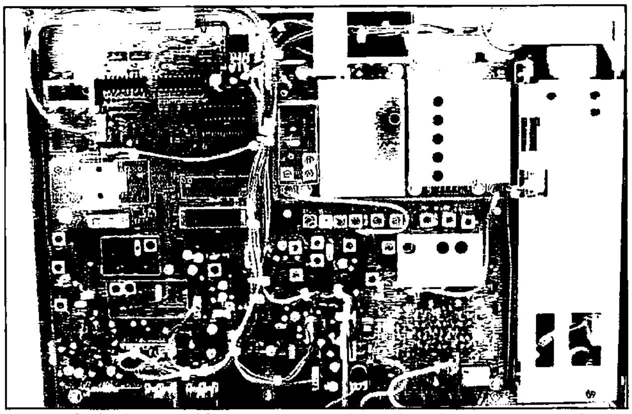


Photo C. Inside the IC-738, bottom view. The rig has a clean layout and appears easy to service. To the right, in the shielded compartment, is the ATU (automatic antenna tuning unit).

The receiver's PREAMP works well to boost receiver sensitivity on the higher bands like 10 meters, but serves no useful purpose on the noise-laden lower bands. (This is typical of many modern HF rigs. Nobody needs a preamplifier when using any reasonable transmitting antenna to receive below 10 MHz.) The IC-738 also has an ATTenuator, which reduces signals reaching the front end and might be useful when receiving on or near the frequency of extremely strong signals.

The IC-738 contains the normal complement of features and functions found in HF base station transceivers of the nineties. I've already mentioned most of the important ones, but a tour of the rig's panel controls would be incomplete without mentioning these as well.

The AGC switch is a push-button that toggles between FAST and SLOW. Although it lacks an OFF or MEDIUM mode, I found it satisfactory for most operations. The AGC performance is good. Concentric to the volume control (labeled AF) is a squelch control (SQL) that functions on all modes but is normally used only for FM work in the 29.6 MHz range. The rig has a pulse-type noise blanker activated by a push of the NB switch. It works as well as most I've used, and does a fine job of reducing ignition noise.

The built-in electronic keyer for CW work has a speed control (KEY SPEED) concentric to the mike gain (MIC) control and adjusts smoothly from 7 wpm to 41 wpm. The keyer works fine, but I usually use an external memory keyer for contest work. Still, an internal keyer is handy in a pinch or for portable work. The previously mentioned antenna switch is an internal relay that is activated by a press on the ANT button, above which are mounted two LED indicators to indicate the antenna ("1" or "2") selected. The ANTenna selection data is normally automatically stored in band memory, but may be overridden at any time by a push of the ANT button.

The RF PWR control adjusts the rig's output power from less than 5 W to full output (100 W, except on AM, where the max is about 40 W). It works well and adjusts output smoothly, but I wish it had a larger knob to make for easier frequent use. Just below the main VFO tuning knob is a tuning brake adjustment screw, turned by a small Phillips-type screwdriver, to vary tuning dial tension. I found the factory setting just about perfect, but you can adjust this to your heart's content, from quite loose (allowing a spin across the band) to fairly tight (won't jar the knob even if the rig is bumped hard).

The main VFO tuning knob operates smoothly and has a weighted feel. Large enough to provide a comfortable grip, it also has a large circular finger-hole depression for rapid motion using a single finger. I liked it a lot. This is one of those features that many hams overlook, but can make a real difference in operating, especially for long periods (like contesting). I wish every rig out there had a tuning knob like this one. Just above the tuning knob is an electronic dial lock switch (LOCK), which prohibits the VFO from changing frequency. I never actually use this function, although most modern rigs offer it.

The IC-738 offers 101 channel memories and six pages of the owner's manual are devoted to describing its operations. The memories will store frequency, offset, mode, antenna selection, and so forth. The memories can be of great assistance in a variety of ways, but I use them mostly for rapid band and mode changes, or to store repeater frequencies in the 10 meter FM subband. A very handy feature is the IC-738's scratchpad memories. These are five additional memories (extendible to 10 if desired) which do not occupy space in the normal 101 memory register, and can be instantly stored and recalled with a single push of the MP-W (Memo Pad-Write) or MP-R (Memo Pad-Read) button. If you want to store the frequency to which you're tuned, and then tune somewhere else, just punch the MP-W button and spin the knob. A single push of the MP-R button instantly recalls where you were before you tuned around. These memories stack up, and the factory default allows stacking five of them; if you add a sixth, the oldest one stored will drop out of the memory, and you'll be able to recall the latest five. This feature is very handy when DXing or contesting, and easier to use than the other 101 memories, which require more thinking and keystrokes.

Like any good, modem rig, the IC-738 has a frequency/band keypad, a set of 12 push-button switches that can be used to change bands instantly, or access specific operating frequencies without the need for spinning the VFO knob. Eleven of these buttons are labeled with band designators and/or the numbers "1" through "0," plus a decimal point. If you're on 80 meters and want to switch to 10 meters instantly, just push the "28" button, and you're there, right on the last 10 meter frequency used. If you want to dial up a specific frequency without turning the VFO knob, that's easy, too. For 14.225 MHz, you'd press FREQ INP (frequency input), followed by 1-4-.-2-2-5, followed by ENT (enter).

Another way to tune around besides using the VFO knob is to use the UP and DOWN buttons, located below the keypad just discussed. If you press and hold either button, the rig will electronically tune up or down the band in programmed steps from 1 kHz to 1 MHz. Having this function on the front panel is almost superfluous, however. The function may be duplicated with the UP and DOWN buttons atop the handheld microphone (and also found on most desk mikes). That can be handy.

Operating "split" with the 738 is as easy as with most modern rigs, and involves using the SPLIT button in combination with the A/B (VFO "A" or "B" select) button. If you wish to check your transmit frequency instantly when operating split, a push of the XFC (Transmit Frequency Check) button will toggle the VFO from the receive VFO to the transmit VFO. If you press XFC and hold it down, the VFO knob may be tuned to change your transmitter frequency to anything desired, without changing your receiver frequency. When you release the button, your transmitter frequency will be whatever was last tuned. Very handy for working split-frequency pileups.

A Quick Tuning switch (TS, for Tuning Speed) allows changing the VFO tuning speed from normal (1 Hz or 10 Hz, user-selectable) to fast (1 kHz) for rapid band excursions. When the normal (slow) tuning mode is selected to allow 1 Hz tuning, a third numeric indicator to the right of the frequency decimal point illuminates; otherwise, when the normal tuning mode is 10 Hz, this digit is blanked and not part of the frequency display. Not a bad idea. Using the 1 Hz tuning mode can be painfully slow and is rarely necessary (can you really hear a 1 Hz change?), although it might be nice when using a sharp CW filter and the NOTCH function.

The mode selector buttons are easy to use and large enough to operate quickly. Located just to the left of the main VFO tuning knob, the mode switches are labeled SSB (toggles between LSB/USB); CW/N (toggles between CW wide and CW narrow if the optional nar-

row filter is installed); AM; and FM/TONE (toggles between FM and FM+CTCSS tone [encode] if the optional UT-30 tone encoder is installed).

The IC-738, like most recent Icom products for HF, has both RIT and XIT functions. RIT, Receive Incremental Tuning, is featured under various names on all HF transceivers made in the past two decades or so. XIT allows similar adjustment of the transmitting frequency, independent of the receiving frequency. Using either one or the two together, you can work split up to about 20-kHz separation, without needing to use the SPLIT function. The RIT and XIT functions are individually addressable but share a common tuning knob labeled RIT/ΔTX.

The rig also has two interference-fighting tools: PBT (PassBand Tuning) and NOTCH filtering. The PBT control has a center off detent, while the NOTCH control has its own separate on/off switch. I found the passband tuning PBT function extremely helpful under a variety of situations, but the NOTCH not particularly useful. Notch filters are mostly intended for reducing the intensity of an interfering single-frequency carrier, and don't help much in reducing interference from a nearby SSB station. Used in combination with some patience and skill, the PBT and NOTCH can complement each other to further reduce some types of interference. But I think the PBT will be of greatest help for most users, and the one in the IC-738 is good.

The unit has the usual scanning features that may be used to frequency-scan between memories or preset band limits. The scan modes are "programmed scan," "memory scan," and "select memory scan," and are described in two pages of clear instructions within the manual.

Technically speaking

The IC-738 uses a triple-conversion receiver with "up conversion" as has become the norm. Its receive first IF is at 69 MHz, second IF at 9 MHz, and third at 455 kHz, allowing the use of conventional bandpass filters. Following the signal path from the antenna jack, received signals are first routed through the antenna switching relay, then through the T/R relay, a low-pass filter, and the receive attenuator switch before they reach either a low-pass filter for reception up to 1.6 MHz, or a set of diode-switched bandpass filters for coverage of 1.6 through 30 MHz. Seven such bandpass filters are employed, each covering an octave or less.

The filtered signals are routed to the receive preamplifier switch, where, if the preamp is engaged, they are amplified by a pair of 2SK2218 JFETs in parallel. Signals are low-pass filtered once again before reaching the first RF mixer, a pair of balanced 2SK2171 JFETs, then are bandpass filtered at the first IF of 69.0115 MHz before being amplified by the first IF amplifier, a 3SK121 dual-gate MOSFET. Received signals are then bandpass filtered once more at 69.0115 MHz before being mixed down to the 9.0115-MHz second IF in a diode balanced mixer, type ND487CIT. LO injection to both mixers is provided by the PLL unit. The first mixer injection provided by the PLL tunes from 69.0415 through 99.11499 MHz, thus allowing continuous receive coverage of nearly the entire 30-MHz spectrum. This output range is achieved by four VCOs having outputs 69.0115 MHz above the received tuning range. (For example, VCO1 produces 69.0145 through 76.0114 MHz; VCO2 produces 76.0115 through 84.0114 MHz, and so forth). The second mixer injection at 60.000 MHz is provided by a frequency-doubled 30-MHz crystal oscillator, also located in the PLL unit.

The 9.0115-MHz second IF is filtered using another 2-pole bandpass monolithic device, after which the noise blanker gate is located. The noise blanker gate is a set of four MA77 diodes driven by a gate control circuit located on the output of the noise blanker loop. The noise input to the blanker is sampled at the 9.0115-MHz IF and is amplified and detected in a noise blanker AGC loop of its own prior to driving the gate control circuit. After the diode gate, the 9-MHz IF signals are amplified once more and then bandpass filtered by one of two 9-MHz crystal filter units. (The 2.1-kHz unit is standard, but an optional narrow CW filter may be installed at this point as well. AM or FM signals continue through the

diode filter switch without filtering and go on to the third mixer, whose description follows.)

The third mixer is an integrated circuit type uPC1037HA having LO injection at about 9.4665 MHz, generated by the crystal oscillator with some frequency shift afforded by the PBT control. This mixer's output at 455 kHz is filtered by one of four diode-switched ceramic filters, three of which are standard (SSB/CW, AM, and FM) and one of which is optional (CW narrow). The 455-kHz final IF signals are postamplified by a 3SK131 DGMOSFET and then directed to either of two additional IF amplifiers (2SK882 JFETs) before reaching the appropriate detector stage for the mode selected.

The detectors used are a uPC1037HA integrated mixer/product detector for SSB and CW; a set of diodes (HSM88AS) for AM; or a MC3357DR integrated FM subsystem that acts as an IF amplifier/limiter and discriminator. Injection to the product detector is provided by a mixer (another uPC1037HA) used to provide the difference frequency of the 9.4665-MHz crystal oscillator previously discussed and a 9.0130-MHz "BFO" crystal oscillator. This difference frequency, minus the 455-kHz IF, provides an audio frequency output from the product detector. This AF output goes through the NOTCH switch and filter before being amplified by a set of cascaded 2SC4081 bipolar audio amplifiers, whose output is level adjusted by the front-panel AF (volume) control before driving another 2SC4081 and the final audio amplifier, a uPC1241H integrated audio amplifier rated at 2.6 W output.

AGC control is provided by an AGC detector driven by the last IF amplifier (455 kHz), then amplified by a 2SC4081 to control the IF amplifiers used at 69 MHz, 9 MHz, and 455 kHz. It is thus an IF-derived control loop that simultaneously adjusts the gain of all the IF amplifying stages in the receiver and is quite effective.

The circuitry is modern and well thought-out to provide a minimum of spurious or image signals. Most of the same circuitry is also used in the transmit signal path, as is typical of modern PLL-tuned transceivers. The primary differences are described below.

On transmit, the output of the 69.0115-MHz bandpass filter (already discussed in the receiver section) drives a 2SK882 JFET IF amplifier (which also provides "S" meter data to a meter amplifier) and then a balanced mixer using a pair of 3SK131 dual-gate MOSFETs, whose output is high-pass filtered to drive a 2SC4673 bipolar RF amplifier. Injection to this mixer Is provided at 69.0415 to 99.11499 MHz by the PLL Unit and comes from the same set of four VCOs discussed earlier for receive injection tuning of the first RF mixer.

The output of the 2SC4673 RF amplifier is low-pass filtered and then attenuated to provide a fixed terminating load for this filter before being delivered to the PA Unit. The PA Unit contains a pre-driver (2SC1971 bipolar, operating common emitter with emitter peaking), driver (push-pull 2SC3133 bipolars, grounded emitter with adjustable base bias), and power amplifier. The final power amplifier (PA) uses a pair of push-pull 2SC2904s, grounded emitter with base bias regulation provided by a 2SD1406 series regulator.

Also located in the PA Unit is the fan control circuit, which appears to be driven by a thermostat and uses a 2SB909M bipolar fan driver. There is no discussion of how this circuit operates, and because I am unfamiliar with some of the parts used, I can't say much about it. But it does work, and the fan in my unit came on within a few minutes of transmitting at full power and kept the unit quite cool to the touch. There are actually two fans used in the IC-738 and they appear to operate in parallel.

The output of the PA is routed to the Filter Unit, a set of relay-switched (12 relays used) low-pass filters using dual pi-sections to cover each band segment (except for the 10/14-MHz LPF, which uses three pi-sections). The SWR-detector circuit, which drives the panel meter to Indicate forward output power and SWR, and also provides reflected power data for the control loop that reduces the transmitter's drive in the event of a significant mismatch (as well as data for the ATU control loop), is also located in the Filter Unit, as is the two-position ("1" or "2") antenna switching relay, RL16.

· The ATU is located on its own board called the Tune Unit. It uses 12 relays to switch combinations of "T"-networks to achieve the best possible match to a wide range of antenna impedances. While Icom's published specifications claim a tuning range of 16.7 to 150 Ohms (thus, it should match any antenna having a VSWR = 3 or less), I found in actual use the tuner was better than this and successfully matched a clip lead on 20 meters. (This was discussed earlier.) I also used the ATU to match rain downspouts, window screens and other ridiculous loads with amazing success. The relay-switched matching network uses fixed input and output capacitors and tuner-controlled variable capacitors across the fixed units, along with combinations of shunt "T" inductors. It's a slick system that works better than most I've used.

In most cases, the ATU can find a successful match point for reasonable antennas within just a second or two. The ATU is in the RF path only when transmitting, which is normal. (It cannot work without a signal being transmitted, and we cannot transmit a signal outside the amateur bands. Thus, the tuner would be useless for the general-coverage receiver without having some way to adjust it manually.) The tuner may be bypassed entirely with a single touch of the front-panel TUNER button. When operated in the "bypass" mode, the display screen indicates THRU. When the tuner is searching for a match, the display screen flashes a TUNE warning. When the match is found, the TUNE indicator stops flashing but remains illuminated.

Conclusions

I like the IC-738. It works very well and is easy to use. It meets its specifications with considerable margin, especially with regard to receiver performance, transmitter output power, and ATU matching range. If this were a perfect world, I'd get Icom to move the VOX controls to the front panel, make the RF power output level adjustment a larger knob, add a three-position rotary switch for meter function control on transmit, add a more readily accessible CW sidetone adjustment, and include sidetone pitch as well as volume, add more mike gain, and improve the owner's manual to more fully discuss some features and functions that are not well addressed.

As someone who has done a lot of technical writing, I'm more critical than most regarding operating manuals. And as someone who has done an awful lot of operating of amateur equipment over the past 30 years, I'm probably also more critical than most regarding control placement. After all this time, I know what I like, and no rig I've ever seen offers everything in one box. But Icom's on the right track. When all is said and done, on-the-air performance is more important than slick manuals and lots of knobs. And the IC-738 performs exceptionally well. It's a pleasure to use under most conditions, and I'll give it a thumbs up as a wise choice for a broad spectrum of users. ■

IC-738 SPECIFICATIONS

Frequency coverage:		
Receiver: 500 kHz-29.995 MHz	Actual: 30 kHz-29.999 MHz	
Transmitter: 1.8-1.9999 MHz	Actual: as published	
3.5-4.0000 MHz	3.4-4.099 MHz	
7.0-7.3000 MHz	6.9-7.499 MHz	
10.1-10.150 MHz	9.9-10.499 MHz	
14.0-14.350 MHz	13.9-14.499 MHz	
18.0-18.168 MHz	17.9-18.499 MHz	
21.0-21.450 MHz	20.9-21.499 MHz	
24.8-24.990 MHz	24.4-25.099 MHz	
28.0-29.700 MHz	28.0-29.999 MHz	
Modes: SSB, CW, AM, FM		
Number of memory channels: 101		
Antenna impedance: 50 Ohms nominal		
Usable temperature range: -10° to +60° C (14° to 140° F)		
Frequency stability: <200 Hz from 1 min. to 60 mins. after power is applied. After that, <30 Hz/hour at 25° C (77° F), and <350 Hz with temperature fluctuations from 0° to 50° C (32° to 122° F).		
Power supply requirement: 13.8 VDC ± 15% @ 20 ADC		
Current drain: 1.6 A receive (2.1 A at full audio output)		
20.0 A transmit at full power		
Dimensions: 13.0" x 4.4" x 11.2" (H x W x D)		
Weight: 19.0 lbs.		
Transmitter output power: 5-100 W	Actual: 2-120 W	
Spurious emissions: <-50 dB		
Carrier suppression: >40 dB		
Unwanted sideband suppression: >50 dB		
Microphone impedance: 600 Ohms		
Receiver sensitivity (preamp ON):		
1.8-29.995 MHz SSB, CW: <0.15 µV	Actual: <0.12 µV	(10 dB S+N/N)
28-29.7 MHz FM: <0.5 µV	Actual: <0.35 µV	(12 dB SINAD)
0.5-1.8 MHz AM: <13.0 µV	Actual: <9 µV	(10 dB S/N)
1.8-29.995 MHz AM: <2.0 µV	Actual: <1.5 µV	(10 dB S/N)
Squelch sensitivity (preamp ON):		
SSB: <5.6 µV at threshold	Actual: not measured	
FM: <0.3 µV at threshold	Actual: as published	
Spurious and image: >70 dB	Actual: >80 dB worse case	
Audio output power: >2.6 W @ 10% distortion, 8-Ohm load		
RIT/XIT range: ± 9.999 kHz	Actual: as published	

Number 11 on your Feedback card

by *Michael Geier KB1UM*

Sony Corporation of America
Sony Drive, Park Ridge, NJ 07656
Phone: (201) 930-1000
Price class: $479

Sony ICF-SW100S Pocket Shortwave Receiver

A Ham Station in your pocket?

Well, not quite—it doesn't transmit. Still. Sony's new ICF-SW100S pocket shortwave receiver is quite a little handful, offering advanced features never before available in such a tiny radio, including some that make the new set of interest to ham operators.

What You Get

The receiver measures 4 3/8" x 2 7/8" x 15/16", and is designed in a clamshell style, like a baby laptop computer. It looks very snazzy, and the control buttons and display are protected when you close it up. The set fits in the palm of your hand and, at 7.8 ounces (including batteries!), weighs next to nothing. It runs on two AA cells for a long time (the manual says 18 hours) or forever from the provided AC adapter.

On the lower half of the clamshell are the buttons, which include power, a numeric keypad for frequency entry, up/down tuning, timer settings and more. On the upper half are the very large display and the speaker, along with a lamp button. On the sides are jacks for the included external active antenna, stereo earphones, line out for a tape recorder, and DC power input. There's also a local/DX sensitivity switch, tone switch, and a master power switch that prevents accidental turn-ons. On the back is a good-sized telescoping whip antenna.

Along with the radio, you get an AC adapter. Curiously, the set is shipped to other countries with a self-adjusting, multivoltage adapter that can be used anywhere in the world. The U.S. version, though, operates only on 120 VAC, even though Americans are the most traveled people in the world. Go figure.

The rig comes with a nice, leather case that screws onto the back of the radio. The case opens up and lets you use the radio without removing it. Also included are a pair of earbud-type headphones, a shortwave frequency guide, and an operating manual. Finally, you get the active antenna. Unlike its predecessor, the SW-1, the SW100S gets its power from the radio, and does not require its own batteries, making it nice and light.

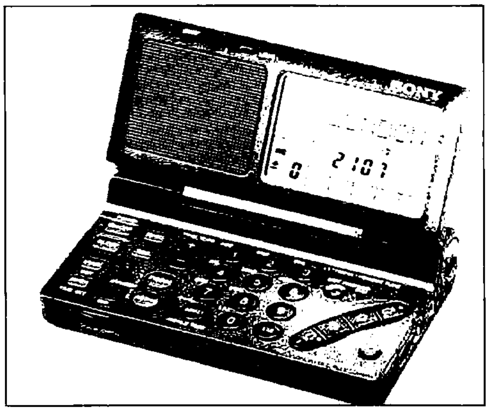


Photo A. The Sony ICF-SW100S Pocket Shortwave Receiver.

What It Does

So what can something this small do? Plenty! This diminutive receiver has digitally synthesized frequency coverage from 150 kHz to 29.999 MHz, plus the FM broadcast band, with FM stereo through headphones. The receiver is dual-conversion, with up-conversion on the shortwave bands for good image rejection. It has 50 memories organized into 10 pages of five memories each, and each memory can store a 6-character alphanumeric label, along with the frequency and other parameters. What other parameters? How about selectable sideband, with true SSB reception? This is not the usual "AM receiver with a BFO" style of consumer shortwave radio. This unit not only lets you pick the sideband but also has synchronous detection for AM, a valuable feature previously found only on much larger receivers.

In the AM mode, the set tunes in either 1-kHz or 5-kHz steps, using the inner and outer tuning buttons (there is no tuning knob). When you hold one of the inner buttons down, the set moves up or down so smoothly it almost seems like analog tuning; you don't hear any "tick tick tick" noise or muting as the synthesizer steps. If you press one of the outer buttons, you get 5-kHz steps. On my old SW-1, I used to like to hold the tuning button, which had only 5-kHz steps, and scan the radio manually, stopping whenever I heard something interesting go by. I liked that better than the automatic scan, which muted the set between stations. Nearly all shortwave broadcast stations are spaced at 5-kHz intervals, so it was very convenient. On the SW-100, though, holding down a 5-kHz button causes the radio to go into scan mode. Even if you keep holding it, the set stops on each active frequency, and you must let go of the button and press it again to keep it going. I prefer the old way, employing a separate scan button. Still, you can hold down the 1-kHz buttons and get the same effect, only more slowly.

In SSB mode, the inner buttons tune in 100-Hz steps, which is a little coarse by ham standards, but still gets you close enough to your desired frequency to enjoy SSB and CW without too much difficulty. The outer buttons change to 1-kHz steps, but they still have the same problem: They make the set scan if you hold them. This makes tuning in SSB awkward, because the inner buttons' 100-Hz steps are too small to get you where you're going fast enough, and the outer ones force a scan unless you press and release them over and over. I find the easiest way to get around a ham band is to go to AM mode, tune for signals with the inner buttons at 1-kHz steps, and then go to USB or LSB and fine-tune in 100-Hz steps with the same buttons.

Memories

At first, I thought that 50 memories on a pocket shortwave receiver would be overkill. How wrong I was! With the ability to store 6-character alphanumeric labels, and the organization of 10 banks of five memories each, it is very tempting to want to put all the frequencies for a particular broadcaster in one bank. Such neat organization makes it easy to find your station on any of its frequencies, but it limits you to 10 broadcasters. Oh well, complaining about having "only" 50 memories is like complaining about great pizza: You love

it. but you can't get enough, no matter how much they give you!

Entering the memories and their names is as easy as could be, given that there's no typewriter-style keyboard. As a bonus, if you want to move the contents from one memory to another, all you have to do is recall it, go to the other memory, and press "enter."

Clocks

As in ham radio, world time is important for shortwave listening. This radio has a versatile world clock with times for major world cities, along with their offsets from UTC. You can easily step through them to find your home QTH, or to know what time it is in Bangkok. Even better, you can rename any one of them you want, so you can change your own time zone to your city's name. Or you can replace it with your own name to prevent any confusion about who owns the radio!

Receiver Performance

With the internal whip antenna, sensitivity is pretty good, but not as hot as on some small shortwaves I've seen. Plug in the active antenna, though, and it's another story. Now the rig will hear just about anything out there. AM-mode selectivity is excellent; if you're more than 1 kHz off, you can tell. At 5 kHz off, you really can't stand it. The filtering is quite sharp for such a tiny set. Frequency accuracy is excellent; the synthesizer seems to be within about 100 Hz, which is much better than any consumer shortwave I've seen before, and approaches the accuracy of many ham rigs.

Lock On!

Synchronous detection is to AM listening what the local carrier is to SSB. In sync detection, a local oscillator is phase-locked to the incoming carrier, replacing it in the detector. Why do that? Long-distance AM signals are subject to a peculiar kind of fading distortion, caused by the fact that fading is somewhat frequency selective. The effect is that the two sidebands and the carrier do not necessarily fade together. When the carrier gets weak relative to the sidebands, the signal starts to look something like SSB, which causes a distorted mess In an AM detector. So, why not simply add in your own carrier? That'll work fine, as long as it doesn't beat against the real one. And that's why sync detectors are synced!

The Sony sync detector lets you select the sideband to which you choose to listen. It's most useful when there's an adjacent station on one side of the desired signal, but not the other (a common condition on the shortwave bands). The effect is startling. In AM, the unwanted station causes a heterodyne, or perhaps some splatter, making listening unpleasant. You press the "sync" button and the set goes to SYNC USB, syncing to the incoming station in about 1 second. If the offending signal is below your tuned station, it simply disappears! If it's above, you just press the sync button again and switch to SYNC LSB, reversing the situation.

Making a good sync detector is not as easy as it might seem. It must lock onto a wildly varying carrier, and it must stay locked through deep fades, or It'll growl as it heterodynes with the real carrier. Sony is famous for its sync detectors, but this one falls a little short of the ideal. It does a great job of removing signals on one side of the one you want, which makes it worth having, but it is less than effective against fading distortion; I couldn't tell much difference with it on or off when the signal faded significantly. And, mine tended to unlock on rapidly fading signals. Oddly, it did it on signal peaks; it held well on fades. Still, even though it isn't the greatest sync detector I've ever heard, it sure beats not having one.

SSB

As I mentioned, this radio gives you true SSB, not just a BFO. It lets you select between USB and LSB. There's very little bleedthrough from the opposite sideband, keeping QRM to a minimum. Unfortunately, the set is quite microphonic in the SSB mode. Walking with it, bumping or jarring it, or even just pressing the buttons causes a warbly effect. Thinking that my first unit was defective, I returned it and got another one. When it behaved the same way, I contacted Sony. They were very helpful, but the their final comment was that "that's just the way it is, due to the radio's size." I suspect the PLL's loop constants are too fast, causing bounce and overshoot when vibration of the coils and crystals causes a slight frequency bobble. That may help the synthesizer lock on frequency faster as you tune, but it makes for instability on SSB. After a second or so of undisturbed operation, it settles down somewhat, but it never completely clears up. Both CW and voice signals always sound a bit warbly. Can you enjoy SSB on this thing? Yes, but forget trying to decode RTTY or SSTV from it, and don't expect full-sized HF rig performance. For that matter, the receiver shows in other ways that it isn't a full-blown ham rig. Signals outside the passband cause significant AGC pumping, especially on 75 meters, and the overall selectivity on SSB isn't what you'd get from a full-sized SSB filter. Of course, that filter would probably be about the same size as Sony's entire receiver!

"Still, the Sony does let you listen to the ham bands on a rig that fits in your pocket, with room to spare for a candy bar, and perhaps it is asking too much to expect it to perform like a tabletop rig."

By the way, although the memories do store the mode, such as LSB or SYNC USB, they don't store fractional frequencies. Let's say you select 3910 LSB and then tune to 3910.6 to receive a station clearly. Now, you store all that in a memory. When you recall it, you'll be tuned to 3910, not 3910.6. It's a little inconvenient, but doesn't seriously detract from the usefulness of the rig.

The Sound

The overall audio quality isn't bad for something this size, but it's not as good as on my SW-1. The tiny, 1 5/8" speaker does a remarkable job, but there's not much audio output power, even into headphones. At more than moderate levels, voice peaks clip and distort. Compounding that situation is the overly fast AGC, which overshoots, exacerbating the fading of signals. My Sony liaison acknowledged the fast AGC, stating that the company feels it helps in some listening situations. As any ham will tell you, though, a slow AGC is nicer for most conditions. I have a very inexpensive, analog pocket shortwave that sounds significantly better than the SW-100S on rapidly fading signals, thanks to its much slower AGC that doesn't allow the receiver sensitivity to get out of phase with the fading rate. On SSB, the fast AGC makes the beginning of each word clip and pump as the '100 clamps down, having opened up too much since the last word. Still, the Sony does let you listen to the ham bands on a rig that fits in your pocket, with room to spare for a candy bar, and perhaps it is asking too much to expect it to perform like a tabletop rig.

What I Liked

The ICF-SW100S is a slick little radio with tons of features. It's easy to use, and it runs for a long time on the batteries. The memory data is nonvolatile, so you don't have to worry about keeping fresh batteries installed, as you do on the SW-1.

What I Didn't Like

The sync detector doesn't disable when you're tuning, causing all kinds of unpleasant noises unless you turn it off each time you search for new stations. It would have been easy to have it disable itself until you let go of the tuning buttons, or until the scanner found a signal.

The AGC speed and the warbly SSB were my biggest complaints. I suspect the AGC is also the cause of the sync detector's unlocking on signal peaks. If they'd slow it down and put in a little more audio oomph, this thing would be darned near ideal.

Conclusion

If you want to listen to everything under 30 MHz on a radio you can take anywhere, this is a great way to do it! The ICF-SW100S is the most advanced pocket shortwave on the market, giving you the world in the palm of your hand. There's nothing else like it.

Number 12 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Measuring Up

As hams, we're used to throwing terms like "frequency," "spectrum," "harmonics," "resonance," and "intermod" around on a daily basis. We know that when we press the PTT button on our radios, we're sending out electromagnetic waves at a specific frequency, with some sidebands around it that relate to our modulation. We also know we could be putting out some energy on other frequencies in the form of harmonics or (gasp!) spurs, especially if we're unlucky and have some kind of technical problem with our radios or antennas. But what does all that really mean? What, exactly, is a frequency and how does it relate to this invisible quantity called the spectrum? With such questions in mind, let's take ourselves out of the time domain and enter the odd universe of spectral thinking.

In any circuit, a voltage or current can have only one value at a time. That much seems intuitive; how can any point on a circuit have different simultaneous values? Yet, it is possible for it to *seem* as if there are multiple events happening at the same time, thanks to time-division multiplexing, which is a fancy way of saying that you can have very rapid changes that seem simultaneous to the relatively slow human nervous system.

A good analogy is music: Its sound pressure waveforms are just like voltage levels in a circuit. It makes sense that the pressure of the air arriving at your eardrums can only have one value at one time. (Of course, in the case of heavy metal music that value may be close to infinity!) After all, how can air be moving forward and backward at the same time? Yet, you can hear many instruments playing together, and it's not hard to separate them all out in your head; certainly, you can tell the difference between the drums and the guitar, or between the oboe and the trumpet. The reason is the same: Things happen fast enough for you to integrate the information over time and filter it all out, even though it arrives mixed together into one composite waveform.

Master of Your Domain

This brings up the concepts of time domain and frequency domain. Our normal way of viewing things is in the time domain. All that means is that events, such as rising and falling voltages or changing air pressures, change over time. Think of a sine wave. Imagine yourself looking through a slit in a piece of paper as a graph of the wave on another piece of paper underneath it goes by as while being pulled left to right. You see a rising and falling spot that represents the voltage as it changes over time, and that's time-domain thinking. By the way, that's how an analog-to-digital device, like the one used to encode music on a CD, works: It samples the music waveform over and over, very fast, capturing a "snapshot" of the waveform's voltage value at the instant of sampling and storing the value as a binary number. Later on, the numbers are converted back into voltages and assembled, step by step, into a very good facsimile of the original waveform. Yup, digital conversion and reconstruction are time-domain processes.

Enter Another Dimension

The frequency domain, though, is a whole other ball of wax. The easiest way to think of it is this: The frequency domain is where events that change over time are considered constant entities unto themselves, with their rate of change being their defining factor, rather than the changes themselves indicating movement! So, the sine wave is considered to be one constant thing, rather than a series of moving voltages. That makes for a different kind of graph, with up and down representing the amplitude of the sine wave taken over a period equal to at least one cycle (rather than instantaneously), and other waves of higher and lower frequencies represented to the right and left.

3-D

Notice I called the time domain a "when" and a frequency domain a "where." To think spectrally, you have to imagine in three dimensions if you want to see everything. Imagine you're looking down from above on a bunch of waves lined up *next* to each other. The time domain of this 3-D graph is from back to front; that is, the waves would be coming straight at you if you were looking at the graph as you would in the time domain. Looking exactly straight down from above, you can't really see the up and down movement of the time domain of these waves very easily. (If you angle yourself slightly, then you can see them a little better.) To your left are waves of lower frequency, with their longer time periods stretching from the back toward the front. To your right are the higher frequencies, with shorter periods. If you're having trouble seeing this in your head, get a piece of paper and try to draw a frequency-domain graph. Of course, without the third dimension of up and down, you'll have to fake the waves' amplitudes. Still, you can get a good idea of what it will all look like. See Figure 1.

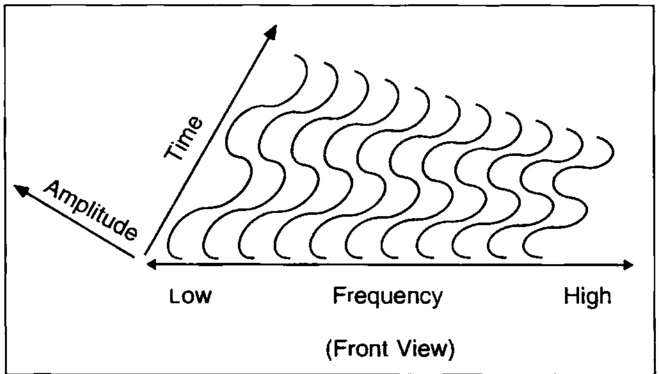


Figure 1. A frequency-domain graph.

What Are Little Signals Made Of?

We all know that signals are composed of rising and falling voltages that force corresponding currents through the resistances of circuits, be they ICs or electromagnetic field-space interfaces (now there's a fancy way to talk about a dipole, huh?). Spectrally, though, what you have are little bunches of frequency units. When you transmit a pure carrier, with no modulation, you get just one wave on the spectrum chart, with nothing to the left or right of it. When you modulate that wave, though, you start spreading out in the spectrum, thanks to the mixing of the modulation with the carrier and its effect of momentarily altering the carrier from a pure, steady sine wave. On SSB, the modulation adds and/or subtracts from the carrier frequency, depending on which sideband you use. On AM, you get mirror-image sidebands on both sides of the carrier frequency. On FM, it's quite a bit more complicated. Still, there are sidebands above and below the carrier frequency; their relationship to the modulation is not as obvious.

Harmonics

Why do a violin and a clarinet playing the same note sound so different? Their unique sonic signatures result from their waveforms, which are vastly different because of the physical structures of the instruments and their different methods of tone production.

A mathematician named Fourier created what he called "transforms" to describe the makeup of various waveforms in terms of their harmonic content. He proved that any waveform could be broken down into its fundamental frequency and its harmonic frequencies. Here's the kicker: Deconstructed in this way, *all* waveforms can be shown to be made of sine waves! Yup, even square and triangle waves. If you filter out all the frequencies above the fundamental frequency of any wave, you'll get a sine wave. It really works, both on a theoretical basis and in the real, physical world. The logical conclusion here is that sine waves themselves have no harmonics. That turns out to be true. In fact, they are the only waves having all their energy on only one frequency.

Does that mean the other

frequencies present are randomly scattered all over the spectrum? No! There's an orderly structure here, which makes sense when you consider that whatever non-sine-wave elements in a wave create, the harmonics have to recur in each cycle of the wave. That suggests the frequencies of these harmonics are multiples of the fundamental, or lowest, frequency. And that's exactly what happens.

Square waves, for instance, have only odd harmonics, meaning there's energy at three, five, and seven times the fundamental frequency, but none at two, four, and six. Triangle waves, on the other hand, have energy at *all* harmonics. So, just how far do these harmonics go? In general, most harmonics decrease in amplitude inversely to their number. So, the third harmonic of a square wave will be at 1/3 the strength, the fifth at 1/5, and so on. Of course, it's possible to have other ratios, but the resulting composite wave will then have a different shape. In the real world, the harmonics don't go on forever; all circuits have upper frequency limits. That's why square waves don't have infinitely fast rise and fall times; the lack of infinite harmonics keeps the rise and fall times finite, and the more harmonics you lop off, the slower those times get. Lop 'em all off and you're left with . . . yup, a sine wave.

Spurs

You've probably heard of this kind of emission, especially with VHF and UHF repeater installations. Spurs are considered non-harmonic energy. This suggests that their cause does not repeat with every cycle of the wave, and that's true. Spurs can be caused by oddities of circuit design or proximity to other signals resulting in mixing products that are not locked to the period of the wave. So, they can be harder to pinpoint, because you can't go looking at some convenient multiple of your carrier frequency. How do you find spurs, or for that matter, harmonics?

Magic Window

Whether or not you've used one, you're undoubtedly familiar with the oscilloscope, which is an electronic graphing machine that presents a picture of voltage over time. Does that help us here? To some degree, it can. If you see an obviously distorted waveform (in other words, anything but a sine wave), you know there is energy on some other frequency. But where? On that question, the good ol' scope fails us. We need something stronger.

It's called a spectrum analyzer. It looks much like an oscilloscope, but it presents a frequency-domain picture instead of a time-domain one, letting us see exactly where the energy lands in the spectrum. Before, though, I said that you needed a three-dimensional graph to do that. Have they invented 3-D image tubes or what?

That would be nice! So far, though, we're still stuck in the 2-D imaging world, for the most part. So, spectrum analyzers squash the time axis flat, showing you only amplitude versus frequency. You can't see the waveforms at all, but you really don't need to. All you need to know are their amplitudes and where they fall on the frequency axis. So, how do you make a measurement device actually work in the frequency domain?

Fake It

You don't! Frequency, being a combination of time and amplitude, doesn't really exist in the direct sense. Even frequency-sensitive, resonant filters really function because of the *time* it takes for the electrical energy to get from one end of the filter to the other and back again. So, to fake a frequency display, we have to go back to the time domain.

A spectrum analyzer is nothing more than an oscilloscope with a narrow bandpass filter that sweeps up the frequency spectrum in step with the beam moving horizontally across the face of the tube. The vertical movement of the beam is made to represent the amplitudes of incoming signals as their component frequencies, a la Fourier, are consecutively passed by the input. You see what appears to be a simultaneous spectrum plot, but it's really a rapidly swept, time-domain fake. You've been had, but in a very useful way.

Next time, we'll look some more at this topic. Until then, 73 de KB1UM.

Number 13 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Please Touch the Exhibits

With the new fall term almost upon us, many of us who teach will be racking our brains trying to come up with new and exciting ideas for field trips. It isn't always easy coming up with an appropriate place for my 6th-, 7th-, and 8th-grade ham radio classes to visit. Fortunately, our school is located in Staten Island, New York, which is only 20 minutes away from Manhattan. New York City, of course, has much to offer in the way of museums and other interesting facilities. The problem has always been to find a highly motivating facility that would be appropriate for the inquisitive minds of preteens. At this age, the youngsters want to get involved with things that pique their interest. This is also an age group that is not known for its long attention span.

The Liberty Science Center in Jersey City, New Jersey, is the latest answer to a science teacher's prayer. This $67 million facility is one of the nation's newest hands-on centers. It is located in Liberty State Park, just minutes from the Statue of Liberty, Ellis Island, and downtown Manhattan. The 170,000-square foot facility features two signature design elements: The Kodak OMNI Theater's geodesic globe housing the world's largest OMNIMAX Theater; and the 170-foot observation tower.

The original plans for the science center came about out of concern for the dwindling scientific literacy among many inner-city students. In 1981, the business community, members of the Research and Development Council, and many prominent, concerned citizens of the state began assembling the plans for an institution that would aid in the development of future generations of science-literate young people.

The Liberty Science Center ontains over 60,000 square feet of exhibition space on four floors, with more than 250 innovative and engaging "hands-on" exhibits, allowing visitors of all ages to experience firsthand the excitement of science and the satisfaction of individual discovery. All the electronics that control the various exhibits are encased in clear plastic for the children to examine. Even the escalator and the computer controls are covered with clear plexiglass.

There is a Health floor that includes a sensory deprivation tunnel and an ambulance for kids to walk through and examine. Many different kinds of body simulation displays are featured requiring interactive participation. The Environment floor is also fascinating. It contains a one-of-a-kind, 60-foot interactive theater showing environmentally related films where the children make choices that control the final outcome of the action.

Photo B. See sound waves interact with foam pellets to create standing waves in the Resonance Tube at Liberty Science Center.

Of greatest interest to me and the children with me was the Invention floor. One section of the floor has a separate workshop area, in which dozens of youngsters were seated working diligently on various individual projects. Several parents were involved with their kids building small motors and generators. There were also four Liberty Science Center employees who were highly visible, moving around the workshop area and offering assistance when needed. In addition to the shelves filled with circuit boards from stereo systems, television sets, and radios, the work area has many reference books and is well stocked with all kinds of tools for kids to use.

The students and I were especially Impressed with the "swap" center. Youngsters can bring in old electronic components and swap them for other items they may need. First the child is asked to explain the item in detail. The LSC personnel then assign a points value to the presentation, which can be used to obtain other electronic items in the showcase. This is truly a wonderful child-oriented facility.

Photo A. Liberty Science Center is conveniently located on the Hudson River, just across from the World Trade Center.

In several designated areas on this floor live demonstrations were going on. We got to see an exciting demonstration on virtual reality the day we were there. Various computers were invitingly set up so that not a single one was vacant. I enjoyed the fact that every time a lecturer asked if there were any questions, one of my kids would inevitably ask if they planned to install an amateur radio station at the center. One of the administrators responded that they were reviewing plans for a radio station.

Professional scientists make themselves available for mentoring of students who are doing research projects at the center. Private contributions and donations from more than 100 U.S. corporations help to support the Liberty Science Center.

For any teacher who is in the tri-state area, a visit to this most unique learning center is a must. If you are a ham radio operator, be sure to leave your suggestion about the value of having a ham radio station at the location. For more information call (201) 200-1000.

ATV

Number 14 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Record-Setting Band Opening

A couple of months ago I wrote about a fantastic DX opening that occurred in the Midwest last Christmas. It turns out that during that opening, a contact was made that surpassed the overland DX record mentioned in that column. The following is an account of the band opening as observed by WilburWollerman K8AEH.

P5 FOG

On the day following Christmas, Wilbur K8AEH arose early for a snack and some coffee. Contemplating whether to sleep in some more, he noticed the thick layer of fog outside. After years of chasing ATV DX on 70cm, he knew that this kind of thick fog usually meant excellent tropo conditions.

Sure enough, he saw that stations from Dayton, Cincinnati, and Indiana were already working into Michigan, Illinois, and Wisconsin. Throughout the day, P1 signals came up to P3 and soon P5 pictures were seen from stations several hundred miles away as the fog really started rolling in. Around 11 pm it was ATV bedlam on 439.25 MHz. No matter where the antenna was pointed, pictures could be seen. Snow-free images were rolling in from Pittsburgh and Wheeling to the east and from Missouri, Arkansas, Illinois, and Wisconsin to the west. There were so many stations on the air that you just couldn't work them all.

Wilbur took pictures of many of the DX contacts. Unfortunately he ran out of film in the wee hours of the morning, just as the band seemed to be peaking out! Now where do you get a roll of film at 3 am? The correct answer is *not* to wake up the XYL and ask to borrow her camera. After she rocketed off of the bed, hitting her head in the process, Wilbur very nearly ended up with her camera permanently embedded in his head!

It turned out to be worth risking his life, since he got some excellent photos of the peak of the band opening.

Record DX

Wilbur's longest contact was with Elmo Knoch K5YWL in Harrison, Arkansas. The signal strength was between P4 to P5 over an incredible 628-mile path.

Wilbur's station consisted of an 88-element J-Beam at 70 feet, a two-stage GaAsFET amplifier and a 1-kilowatt (dual 4CX250Bs) amplifier with its own video and audio modulator that was driven by a 2C39 exciter.

Elmo K5YWL was using a quad array of FO-22 antennas at 76 feet and a 100-watt Mirage amplifier. *Thanks to Wilbur Wollerman K8AEH for the above information.*

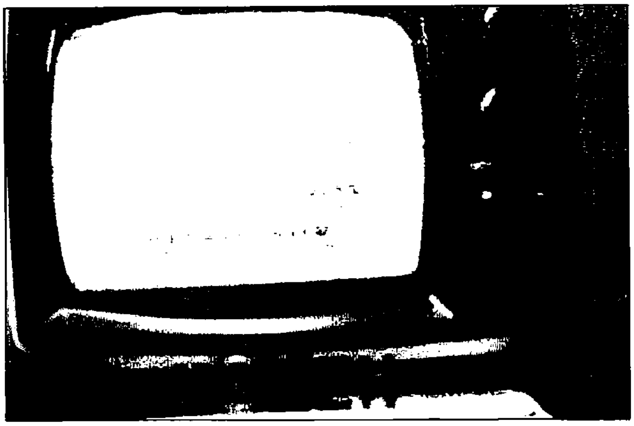


Photo A. Actual reception of Elmo K5YWL's ATV signal from Harrison, Arkansas, as seen by Wilbur K8AEH in Reynoldsburg, Ohio. Photo by K8AEH.

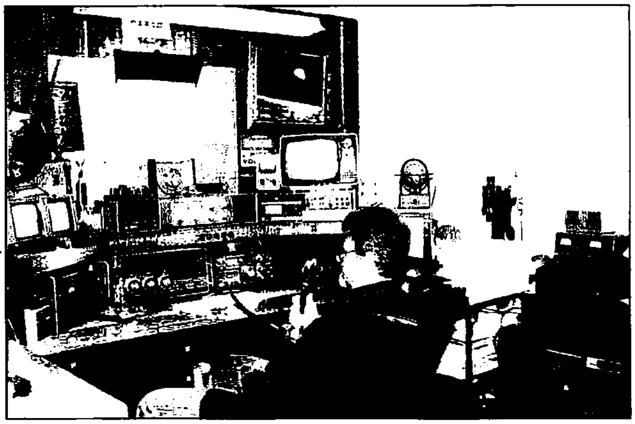


Photo B. Wilbur K8AEH makes the record-breaking ATV contact from his hamshack during the Christmas band opening. Photo by K8AEH.

DX Observed from K8AEH

WJ9Z	St. Francis, WI	WB0ZJP	O'Fallon, MO
K9SM	Hillsboro, IL	N8TSM	Lansing, MI
N9AB	NW Chicago, IL	KA8VSV	Detroit, MI
W9MZH	Fort Wayne, IN	KA3FZF	Monroeville, PA
AA9IG	Peoria, IL	N8AW	Jackson, MI
KA9TGX	Lafayette, IN	W8AHY	Lansing, MI
N9LBN	Milwaukee, WI	W9LPR	Milwaukee, WI
W9NTP	Waldron, IN	WD9ASI	Chicago, IL
K5YWL	Harrison, AR	N8TBM	Lansing, MI
KA9VXS	Lafayette, IN	WA4GSS	Ashland, KY
K3IBD	Pittsburgh, PA	KA8VZV	Wheeling, WV

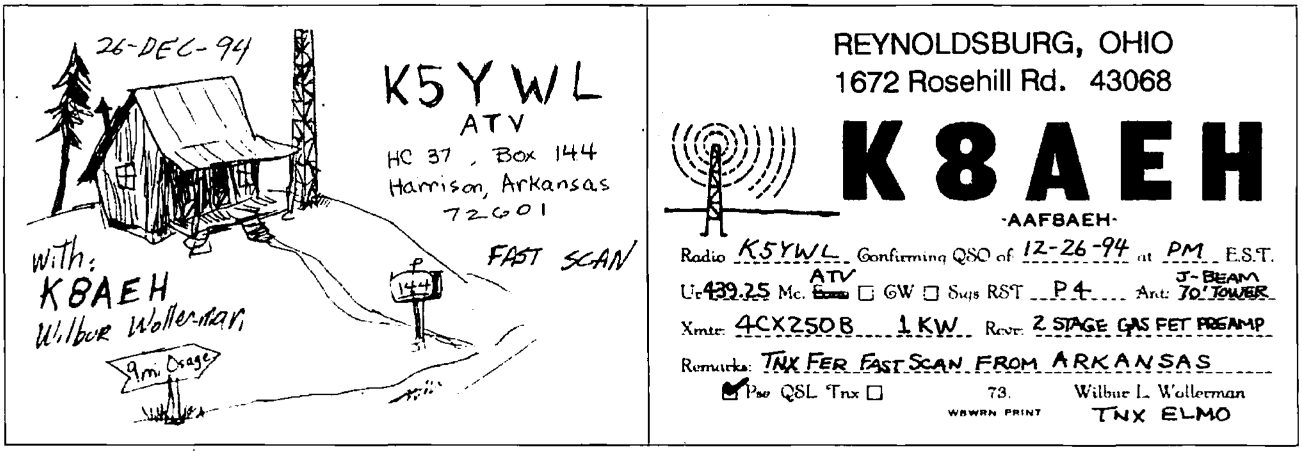


Figure 1. QSL cards confirming the record overland DX contact of 628 miles between Arkansas and Ohio.

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
P.O. Box 2508
Fullerton, CA 92633

The T Is on! Let's Find It!

If you drive the freeways and surface streets of southern California, you're sure to see some cars, vans, and jeeps zipping along with unusual antennas on top, turning erratically back and forth. You may have encountered a group of them parked on a hilltop (see Photo A) and noticed blinking display boxes on the dashboards.

Two meter operators here are used to hearing strange beep-beep signals on 146.565 MHz simplex, and sometimes through repeaters, too. They have CW or voice identifiers giving "T numbers." On some weekends, half a dozen are on the air at a time!

As you have probably guessed, the hams with the weird mobile antennas are trying to find the sources of the weird signals. They call it "T-hunting" because they are looking for hidden Ts (transmitters). The sport is growing and spreading to large cities and small towns across the country. In some places it's traditionally called "foxhunting" and the hidden station is called the "fox." The technical name for the process is radio direction finding (RDF).

T-Hunting Basics

The idea is simple: One or two hams take a transmitter, antenna, and some sort of distinctive audio source to a carefully chosen spot, and then make continuous or intermittent transmissions. Usually the T remains stationary throughout the event, though mobile "bunnies" are allowed once in a while. The hunters, as individuals or in teams, do their best to home in on the hidden station with their mobile and portable RDF gear. Sometimes there are multiple foxes to be found in sequence. Prizes for the winners are rare; usually there is only fleeting fame, glory, and the opportunity to be hider for the next hunt.

Photo A. At sunset on a summer Saturday, southern California T-hunters gather on a hilltop to have their odometers read before the hidden transmitter comes on the air. Most have yagis or quads on rotatable masts extending through their vehicle roofs.

Every team competes independently. Neither clues nor outside assistance are allowed. While the majority of southern California T-hunts are on two meter FM simplex, a few beginner-level hunts are on repeater inputs. That makes it easy for everyone to tell when the T is on the air.

Southern California is the undisputed T-hunting capital of the USA. There are over 20 competitive hunts each month. The majority start in Los Angeles and Orange counties. Monthly hunts are also available in Riverside, San Diego, and Santa Barbara counties. The latest T-hunt calendar, published by Cathy Livoni KD6CYG, shows hunts scheduled for every day of the week except Tuesday. (Hmmm . . . .)

Each monthly hunt has its own set of rules. Some are very strict, defining the number of Ts, length of transmissions, antenna polarization, boundaries, proximity to roads, time limits, and so forth. On the other hand, a few merely demand that a T be copyable at the start point or through a repeater. Just about anything else goes on these "no complaints" hunts.

Hunts are scored by one of two methods: first finder wins or low mileage wins. A few groups like timed hunts because they simulate the urgency of hunting for repeater jammers or QRM. But the vast majority prefer mileage hunts because they are more like a rally than a road race. On a mileage hunt, there is plenty of time to plot bearings carefully and plan strategy (see Photo B). Odometer-calibration differences are easily resolved because hunters obtain an odometer correction factor in advance of the hunt by driving a standard course.

The boundaries of the three monthly two meter Saturday night hunts are all different, encompassing areas ranging from 78 to 2,320 square miles. The hidden T could be 50 miles away on the Pathfinder hunt, which has the largest of the three boundaries. This hunt typically lasts from three to eight hours.

The varied terrain of southern California adds excitement and variety to T-hunting. Most hunt boundaries include flatlands of urban Los Angeles and Orange County, plus the Chino and Puente Hills, some of which are over 1,000 feet high. Other hunts include even higher mountains. With careful planning (and a little luck), the signal's characteristics will entice hunters to approach the T from the most difficult direction, with impassable roads or other obstructions, even though the T is easily reached by other routes. Sometimes the hider camouflages the setup so well that the hunters don't discover the transmitter unless they literally trip over it.

The most challenging of all are the All-Day Hunts. But that's a misnomer—a better name would be All-Weekend Hunts. They start at 10 am on the fourth and fifth Saturdays of each month. There are five types of All-Day Hunts. Rules for four of them allow the transmitter to be anywhere in the continental USA.

Hiding spots for All-Day Hunts have ranged from the banks of the Salton Sea, 228 feet below sea level, to the top of an 8,350-foot mountain peak. The distance record is currently held by Jim Forsyth AF6O and Eric Nansen N6YKE, who hid four transmitters in four states on one hunt. The farthest was in Utah, 344 miles from the Rancho Palos Verdes starting point. To provide an audible but deceptive two meter signal back to Palos Verdes, All Day Huntmasters often invent very unusual transmitting setups. For example, Jim Ford N6JF and Gordon Nichols K6KYW have used a 35-element yagi antenna with a 100-foot-long boom!

Why Big Beams?

More often than not, Los Angeles area T-hunts involve weak signals. You may have solid copy on the T from the hilltop starting point, only to have it become faint or disappear as you drive down the hill. If you start out in the wrong direction, you might not hear it again! Even if you go the right way, you could travel for many miles before acquiring the signal. For this reason, experienced southern California hunters maximize their receiving sensitivity. They prefer high gain antennas such as quads and yagis for getting their bearings.

Three- to six-element cubical quads are the most popular T-hunting beams. Usually they have a boom of wood or PVC pipe. Elements are made of thin wire (AWG 20 or 22) strung on Fiberglas spreaders in "diamond" form. Some hunters, myself included, prefer to use PVC element spreaders and heavy (AWG 10 or 12) wire formed into square elements. This design is more resistant to the dreaded "quad eating willow." When mashed by low-hanging tree branches, it is easily reshaped and returned to service, whereas thin-wire models tend to suffer wire breakage.

Yagis are a close second to cubical quads in popularity. Commercial models work fine, provided that they have a well-matched feedline, rugged construction, and good mechanical balance. Occasionally you will see some other kind of directional antenna such as a circular-element quad, a "ZL special" phased array, or a delta quad, affectionately known as a "turkey rack."

Rules usually allow transmitting any wave polarization. It is important for hunters to attempt to determine the hider's polariza-

Photo B. Low-mileage-wins T-hunting encourages careful driving and meticulous plotting of bearings. John Roberts WA6LAB is getting ready to start on the Southern California Six Meter Club's monthly hunt on 50.3 MHz simplex.

Photo C. With a little thought, you can come up with a simple no-holes way to mount a rotating beam through the passenger window of almost any car. Put some sort of thrust bearing in the armrest at mast bottom for easy turning at highway speeds. Mount the beam so that a twist of the boom changes polarization.

tion and match it for receiving. A team using the wrong polarization is at an extreme disadvantage, because direct signal pickup is reduced and signal reflections (multipath) from buildings and terrain features are enhanced. Depending on circumstances, such a team may do nothing but chase reflected signals for the duration of the hunt!

Most hunters install some sort of slip joint at the beam's boom-to-mast junction. They rotate the boom to match the signal polarization at the start of the hunt, and sometimes along the way. A few builders add strings and pulleys and are able to conveniently adjust polarization from inside the car.

Doppler RDF sets have not caught on among southern California T-hunters due to their lower sensitivity, compared to beam set-ups. Vertically polarized doppler antennas are at a competitive disadvantage when the hider transmits horizontal polarization. Around here, dopplers are better suited for hunting repeater jammers, who usually use high-power and vertically polarized antennas.

Photo D. James Swenson KC6YSV figured out a clever way to mount his yagi atop the car roof without drilling a big hole. Handles at each end of the PVC pipe framework allow both driver and passenger to rotate the yagi.

For the same sensitivity and polarization reasons, switched dual-antenna RDF sets sold by companies such as BMG Engineering, Ramsey Electronics, and Radio Engineers are seldom used for mobile T-hunts in southern California. However, some teams employ them at the end of the hunt, when signals are strong, for searching out the T on foot.

Jump Right In

Isn't it great that the RDF method most suited for T-hunting on two meters is also the simplest and cheapest? This means it's easy to join in your club's T-chasing antics without a lot of work and expense. Just mount a beam antenna to your vehicle and off you go!

As a beginner, you'll do fine by lashing up a simple passenger-side, through-the-window mount that secures the mast bottom in the armrest and holds the mast center in place next to the top of the window frame (see Photo C). Why the right side? Because your state's vehicle code probably has a provision that outlaws left-side overhang. Nothing must protrude beyond the line of the fenders on the driver's side, but a few inches of overhang are permitted on the passenger side. Check to be sure.

The ideal place for a mobile RDF beam is above the center of the roof. Thus both driver and passenger can rotate it, the effect of the car's body on directional pattern is minimized, and you can use a bigger beam without worrying about overhang. If you have a sunroof, you can probably figure out a quick weatherproof holder for the mast. Some hunters have developed suction-cup mounts with belt or rod-and-crank links to go atop a vehicle (see Photo D).

The bold way, of course, is to drill a 2-inch diameter hole through the roof. Most serious hunters in southern California have overcome the objections of family members and gotten out the hole saw, as you can see from Photo A. No matter how you mount the mast, be sure to include some sort of indicator to show mast position. Straight ahead is zero degrees, dead right is 90 degrees, and so forth.

Getting a beam bearing is easy and intuitive. As you rotate your antenna, watch your receiver S meter for maximum signal indication. Carefully rotate back and forth to determine the exact peak. If the signal is too weak to view on the meter, open the receiver squelch and use your ear to detect the direction corresponding to greatest "quieting" of the noise. When you get so close that the S meter goes off scale, add RF attenuation in the feedline as necessary. Most hunters use simple resistive RF attenuators, home-built or bought for a few dollars at a ham radio swap meet.

T-hunters agree that you can't have too many maps. Start collecting them now; you will need them. Mount a map of the entire hunt area on a board with clear covering so you can plot and erase bearings. A good car compass is a big help in taking mobile bearings relative to true north. You can mount the compass at a slight angle on the dashboard to offset the magnetic declination (the difference between magnetic north and true north in your location). Carefully follow the compass calibration procedure to compensate for the effect of the vehicle body.

To get a true bearing (a bearing relative to true north), add the true vehicle heading to the mast indication. If the sum is greater than 360 degrees, subtract 360. For example, if you are heading down a westbound street (270 degrees) and the beam pointer reads 130 degrees, the true bearing is 40 degrees.

A few hams prefer to T-hunt alone, but most say it's much more fun to team up. The driver concentrates on handling the vehicle, while the DFer turns the beam and calculates bearings.

The DFer also handles maps and plotting (navigating), unless there is a third team member for that task.

You Gotta Sniff, Too

On most hunts, you won't be able to drive all the way until you can touch the hidden T. It may be up a tree in a park, buried on a hillside, or under groceries in a shopping cart. Searching out a T on foot is called "sniffing." Special sniffing gear is great if you have it, but you can usually find the T with just a handi-talkie and simple accessories.

The simplest way to get a bearing in the field is the "body fade." Hold your HT tight against your chest and spin around slowly, looking for the direction at which your body blocks the signal most effectively. At this point, the signal is coming from behind you. When you are so close that you can't find the signal minimum, remove the HT's antenna and try again. For even more signal reduction, use a cardboard tube about 3 feet long and 4 inches in diameter, covered with aluminum foil (leave both ends open). The more you lower the HT into the tube, the more signals are progressively attenuated.

It's not practical to use a directional antenna and ordinary resistive attenuator with a hand-held for sniffing at close range. Strong signals will penetrate the case of the HT and make it impossible to get bearings. In a pinch, you can reduce signal level by tuning the receiver 5 or 10 KHz off frequency. If you have a dual-band hand-held, you get will the equivalent of 40 to 60 dB attenuation by tuning it to the third harmonic of the hunt frequency. A small UHF yagi or quad will give sharp bearings on the hidden T's third harmonic when you are within a few dozen feet.

More Toys

As you gain experience and skill, you will want to add additional gadgets to increase hunting enjoyment (and win more hunts). Early on, you'll see the need for a large easy-to-read external S meter (mechanical or LED bargraph) on the dash. Another favorite add-on is an audio S meter, so you can keep eyes on the road and yet hear signal level fluctuations.

To increase sensitivity to hear those really weak Ts, build or buy a low-noise RF preamplifier, add a noise meter to measure t he FM quieting of the signal, or a beat-frequency oscillator and single-sideband detector. For occasions when strong signals penetrate your mobile receiver's case, build an internal gain reduction system. All these projects are fully described in the 323-page book *Transmitter Hunting—Radio Direction Finding Simplified*, available from Uncle Wayne's Bookshelf.

As in any other specialty of ham radio, the more T-hunting gear you have, the more you want. But don't be intimidated by all the gizmos you see in the big vans and little jeeps of the long-time RDFers. A beam, attenuator, and good receiver is all it takes to find most Ts, and it is not unusual for a beginner to beat the "big guns." Go on a hunt and see for yourself. Bring the family; it's a great "togetherness" activity. If there are none in your area, get together with the leaders of your club and schedule one. Be prepared for some pleasant surprises. When you set out on a hunt, you never know where you'll end up, and you never know what you'll find.

Get The List

If you think it's hard to find information on T-hunting, you haven't been reading *73 Amateur Radio Today*. There has been far more on the subject here than in any other ham magazine. When answering reader inquiries, I frequently can't remember which of the 80 Homing In installments to date cover a particular RDF topic, so I put together an index of titles and subjects.

If you would like a copy of the Homing In Index, send me a self-addressed stamped envelope. My address is at the beginning of this article. If you have the capability, request the index by E-mail and I'll send it in a return message. My Internet address is HomingIn@aol.com and my CompuServe ID is 75236,2165.

While you're at it, tell me about T-hunting activities in your home town. Your photos are welcome, too. Future columns will cover unusual T-hunting customs across the country and around the world; so let's hear about yours.

Number 16 on your Feedback card

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119

The Surplus Cellular Telephone —900-MHz Component Parts

Well, last month we covered HP power meters and the selection process for surplus power heads. I hope you now have all the information needed to test and evaluate used surplus power meter heads and avoid purchasing *defective* ones. I have been using the resistance check method described last month and it has worked out very well as a field evaluation test. I want you to benefit from my experiences also and so avoid the purchase of a defective unit as they can be quite costly even as a bargain. A bad or unbalanced power meter head is not a bargain if it will not function. I just don't want to see anybody purchase a bad or defective product if they can help it. After all, the dollar we spend is usually from a tight budget.

So many people have asked me how our group keeps coming up with new material all the time. Others have looked but have not had as much success as we have enjoyed. I have heard this scenario many times. The area you look in might not be as fertile for electronic scrap as the San Diego area is. Even with the large manufacturing base here in electronics, we still put forth an effort to locate used and surplus material from sources that are new and interesting.

I guess it's a little like fishing. My son is so good at fishing that he goes just for the sport of catch and release. He will tell you what type of fish he has on his line when he has 50 feet or so of line still to reel in. At that point the fish is not struggling with the line, just being tempted by the bait. He can hand the line to me and describe what to notice and I feel a dead line, and will bet on it (the first couple of times). Handing the rod back to my son, he will reel in the fish he described and collect from the old man.

Locating surplus material is similar. Kind of like putting a blood hound on the trail, but not knowing just what might turn up. In many cases it's like drilling for oil—another dry well. But a good part of the time pay dirt is struck. It's just good perseverance and sticking to the trail of good, usable items that make the chase worthwhile. You don't have to reveal how many dry wells you had to dig; you can only talk about the ones that struck pay dirt. People will think of you as a keen hunter.

Here's some real pay dirt, another surplus material idea that can pay off in short order. I am talking about the *cellular telephones* that are becoming available for almost nothing. At least that's what is happening here in San Diego. It seems that the cellular telephone companies here are offering new miniature cell phones for as little as *one percent* of full price. There is a hook: You guarantee to purchase cell phone activation and keep it active for one year of service. To make it more lucrative, you get credit for 10 minutes of air time for each month's usage. As long as you don't engage in long-winded conversations, the cost of these small new phones is such a deal that they are being snapped up faster than peanuts at a ball park. You ask what does that mean to me, the radio amateur. It means that the older briefcase-type telephones that weighed in at five pounds are being scrapped at unprecedented rates in preference to the newer, very small lightweight purse or pocket-type replacement phones.

Inside the newer type of phone you can see a very miniaturized, highly integrated circuit, almost unrecognizable as a RF transceiver for UHF operation. The newer phones are almost not worth retrieving components for amateur uses. Yet this prospect is not bleak, for the larger units are very unpopular and unwanted by the cellular companies. To the radio amateur, these larger units are just what the doctor ordered.

The larger units were constructed with discrete components and larger modules to construct the cell phone's circuitry. This large weight and older technology (discrete construction) makes a unit from which we can salvage portions of circuitry that can be used on the 902-MHz band. Now I haven't tried all the possible ideas but want to mention a few before all of these older, large phones disappear from the market.

The unit that started this train of thought was a mobile permanent trunk type of cell phone that I picked up for $1. It was missing all the interconnecting cables but the basic phone unit was intact. Upon removing the unit's case, I noticed immediately the very large PC board controller for the phone's operation. It was a circuit board about 8" X 10" long. It was stuffed with chips and other components that seemed to be very complex, but not of any great interest for our use. Apparently this unit took care of the housekeeping of the cell phone's operation and had nothing to do with the RF end other than being the processor for synthesizer control.

The other side of this cell phone was more interesting from a pure RF operation standpoint. This side contained four modules, a diplexer antenna module, a transmitter power amp module, a receiver module, and a synthesizer module. See Photo A for a graphic depiction of the circuitry involved in this part of the circuit. Because the circuitry is large, it invites our consideration for salvage operations. Taking a close look at Photo A, you can see some of the larger components, including two VCOs for 800 and 900 MHz. Also included are the standard chip set rather than miniature surface mount chips. These larger components make it very easy to recover and reuse whole circuits or individual parts. This goes for the processor on the other side of the board. I don't believe modification is in order for the processor, but component part salvage is.

For the RF side of the board, a prime PC board for intact removal is the receiver circuitry itself. Looking at the PC board with the cover plates removed, you can readily identify the RF amp, mixer, and LO Inputs. I haven't tried to trace the power pins back, but with all the electrolytics and full-size standard ICs, it should be easy to back trace DC power leads. I have found many such PC boards that have lent themselves to reverse engineering for developing partial schematics of the particular PC board circuit you wish to utilize.

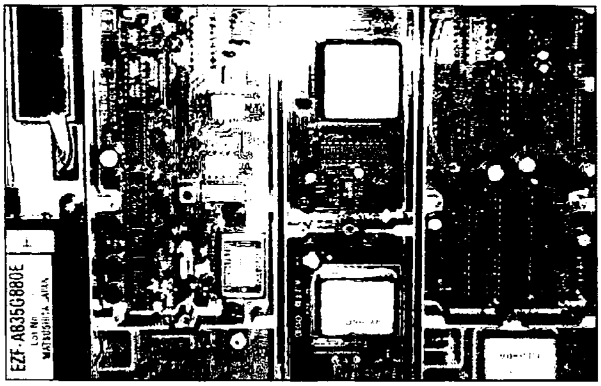


Photo A. Large-scale circuitry (relatively speaking) invites consideration for salvage.

It's a good electronics game to sharpen your skill level on component and circuit identification. This type of operation lets those who try, to make something inexpensive into a very usable device. Sort of making a sow's ear into the proverbial silk purse. Even if the project does not realize all your ambitious plans, remember: It was obtained for very little and the most you can lose is effort. Along the way, however, you have gained quite a lot of solid technical updating by the reverse engineering process and delving into technical pubs for IC pinouts, trying to make use of the PC board you selected.

In my case, I removed the main PC board and tossed It into the component salvage pile for plain old PC boards; nothing special about this board but some parts at a later date. I removed the four RF modules and tried to make some sense out of two of the boards. First, just what does it take to make the synthesizer run and is it convertible? Or better, are there some VCO components to use in construction of another, simpler synthesizer. This is the approach I took for a 902-MHz converter to be constructed out of this heap of parts.

In regards to the receiver PC board, much of the circuitry was quite standard in design, with a basic receiver block diagram layout adapted to the PC board. This unit I removed gingerly as I believed I could make use of this unit with a minimum of conversion modifications. One great feature of this receiver unit is that the receiver subdeck is totally enclosed in its own shielded compartment. This will make its use in the 902 MHz receiver quite neat in appearance. The shielded enclosure will allow modifications to the original PC board to be covered by the shield plates, thereby retaining the shield function.

Figuring the synthesizer input and IF frequencies used should be of little difficulty, as they can be bypassed while the unit is function tested on the work bench. In place of the synthesizer, a bench signal generator will supply the local oscillator frequency during testing. A 2 meter HT will serve as the new IF for both up and down conversion. Power connections and control of the receiver now only need to be reverse engineered. While the receiver is in a mock test jig, all sorts of modifications as needed can be attached or removed from the original circuitry to bring the receiver back to life.

Inasmuch as we are starting this project on a radio that has no accompanying information or schematics, this conversion will have to be an individualized task. It's not a difficult one, but rather fun-filled at reusing the quality circuitry for another amateur band, especially as these units can be obtained for little or nothing. That is what makes the appeal universal. Diligent calling around in your own part of the country will obtain you some of these larger junk cell phones. Even if you have to pay for the unit, it can't be very much. As I stated before, these larger units are a drug on the market and are not wanted.

Check out your local cellular telephone companies and retail suppliers of cell phones. Talk to the technical people, if possible. An especially important note: Make sure the cellular people know that you do not intend to use the equipment for commercial purposes, that it will not be "resurrected" on the cell network. This remark is usually enough to divert some material from the scrap heap into your modification workbench. In this light, be prepared to pick up a partially wrecked phone or one that has been disabled. Even the transmitter circuit of these phones includes a module that is capable of output powers of from 1–3 watts. This varies from model to model, but it still is a source of good components.

I studied the unit that I picked up for quite some time and determined that the units for my conversion will be the synthesizer and the receiver front end. I plan to save the other components for a later project or stocking the junk box. Don't be hasty in disposing of the remaining dregs from the cell phone; they could be put to use in other projects.

The synthesizer circuitry appears to be quite straightforward in design. My unit used a 900-MHz voltage controlled oscillator under the control of an MC-145146 synthesizer chip. Also on this same subchassis was a temperature-compensated crystal oscillator (TCXO) at 12.45 MHz. I have yet to test this module fully but, looking at the synthesizer chip, I can see that its programming lines are coupled off the board for control to the processor side of the original cell phone. My hope is that the synthesizer chip can be controlled by a dip-switch type of programming on the input synthesizer control lines. If this proves to be true after the power lines are determined for this board, it will be up and running on clip leads on the bench.

Well, I don't mean to say that clip leads will be used for everything. A point to remember when making a mock-up connection on the test bench is that lead length can be a factor in the test configuration. For DC power connections, clip leads can most certainly be used and work well. Where long leads or connections must be dressed properly or kept to a minimum is in the RF output (coaxial), and in the programming lines. If the oscillator and the RF divide by circuitry prior to coupling to the lower frequency synthesizer chip, these leads must be very short and property dressed to maintain circuit operation.

Any attempt to use clip leads on the prescalar leads to the divide would result in a nonfunctioning circuit. What can you do? Take a look at how the circuit was originally tied together and try and maintain similar connections between the portions of the circuitry; learn by making it just like the original circuit. Anything resembling the original circuit should function reasonably well in a mock-up test configuration.

I designed a similar synthesizer many years ago, using components from a CATV control box. I used the Plessey divide-by-256 and a voltage-controlled oscillator that was regulated by a Motorola MC-145106 synthesizer chip. I intended to have a dip switch control the pull up leads on the synthesizer chip and put forth a schematic on that. The same circuit was used with the CATV tuner just a few months ago.

Back to the synthesizer chip in the cell phone: Mine was a Motorola MC-145146 (I looked up the device) and is processor controlled. That eliminates any concept of adapting a dip switch to lock the device to a usable LO frequency. I am looking at the possibility of pulling the original chip and replacing it dead-bug-style with the experimenter's special, the old MC-145106, a manual dip switch programmable synthesizer. What makes this chip suitable is the pin dip switch programming capabilities, and that I have a small quantity of them on hand.

The receiver front end I removed looked quite easy to convert to a simple down converter for 10.7 MHz, the IF frequency. The rest of the circuitry should just be removed, unless you want to trace it out for the possibility of reusing more of the circuitry. I took the easy way out by coupling the existing 10.7-MHz IF chain to an external circuit. You can put the remainder of the circuitry in the parts bin. Hey, when you pick up an old cell phone for less than a couple of bucks, there will be lots of extra parts for the junk box. In any case, there are still quite a few high-speed CMOS chips that can be smoked off with a heat gun. Hope you have fun ripping and tearing apart circuitry from your cell phone, your new source of parts for the 900-MHz band via surplus.

Mail Box

Pierre Binggeli HB9IAM of Geneva, Switzerland, is quite interested in the 1-watt power amplifier that is converted from 14 GHz to our 10-GHz band. He plans to use it for ATV at 10400 MHz. Pierre requests information on the conversion and modification details on retuning to 10 GHz. He is also looking for information on Frequency West or similar MS-740V microwave sources with modulation input.

Well, Pierre, I am sending you the conversion information and schematic details on the 1-watt poser amp. Also, I will include some schematic info on Frequency West "brick"-type frequency sources that I happen to have. I plan to cover the conversion of the 1-watt amplifier and other component parts (especially the synthesizer) in another column. There has been quite a lot of input since the last presentation, so the new information should receive the widest dissemination.

John Zima WA2OSA writes, "I have read your column in *73 Amateur Radio Today* magazine and am quite impressed with the way you make the 'art' of UHF and microwave simple to the layman. I have attempted some of your conversions with some actual success. The one I liked best was the conversion of a TVRO LNA feedhorn into a wideband amplifier. That was a painless conversion. Do you have any plans to convert a similar unit to a GOES weather converter?"

Well, John, I haven't had a plan to include such a unit, but I do see the need and will try to convert a similar TVRO LNA, or more properly a LNB/LNC, to a 1691 converter. The LNA was just a preamp while the LNB is a complete preamp mixer oscillator and IF amplifier. I will try to work out some of the details for this column next month on this conversion. I have a few ideas that look like a natural. Be on the lookout for suitable LNB TVRO converters to adapt to this mode of operation. The innards of the LNB should provide all the circuitry necessary for the 1691 converter, except for the local oscillator. More next month. Other projects include developing a very miniature 10-GHz transceiver converted from some of the newest microwave surplus just becoming available. Still working out the details and conversion information and will fill you in when it becomes complete.

As always I will be glad to answer questions on this and other similar amateur-related topics. Please send a SASE for prompt reply. 73 Chuck WB6IGP.

HAMSATS

Number 17 on your Feedback card

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston, TX 77083

Field Day Via Satellite

It was great. Activity was up on all the satellites this year. During June's Field Day weekend, the transponders were packed on the analog hamsats and the queues were full on the digital birds. The American Radio Relay League (ARRL) rules were the same as always, but modifications to the Radio Amateur Satellite Corporation (AMSAT) rules provided the impetus for many to pay attention to anything in the sky that might provide a few more points.

The ARRL rules are simple with regard to satellite activity and have not changed for many years. One satellite contact is worth 100 bonus points. Satellite contacts are viewed as a "band" like 80 or 40 meters for normal scoring. If a station worked K7TR using CW on AMSAT-OSCAR-13 Mode "S" (70 cm up and 13 cm down), a subsequent CW contact via RS-12 (15 meters up and 10 meters down) would be a "dupe." However, the rules do not reflect the reality of today's hamsats. Unlike the 80 meter band, the satellite world is constantly changing with new orbiting systems using HF frequencies up through the microwaves.

The AMSAT rules are quite different. Each satellite is considered a "band." During this year's Field Day, seven satellites were available for analog modes, and several more for digital communications. Special rules for the digital pacsats provided extra points for uploaded and downloaded Field Day greeting messages. Due to the nature of the broadcast-style packet protocol of the digital pacsats, it was possible to score points just by monitoring the downlink and collecting messages requested by other users without ever transmitting.

No limit was placed on the number of stations in use at any one Field Day location. Some groups like K7TR set up three satellite positions. One was specifically for RS-12 work while the other two covered the digital satellites and the high, elliptical-orbit hamsats like AMSAT-OSCAR-10 and A-O-13. For participants it provided an opportunity to focus on specific satellites. For observers it provided examples of different satellite-station configurations for unique modes. A station for mode K usually consists of dipoles for antennas and HF rigs. A mode S installation may use a parabolic dish to receive, a helix for transmitting, and a mix of converters in conjunction with VHF and UHF radios.

"The ARRL rules are simple with regard to satellite activity and have not changed for many years."

The N5EM Experiment

The Houston AMSAT group has made satellite activity the primary focus of their Field Day operation every year. If the HF position interferes with hamsat chasing, the HF is either shut down or moved to another band. This year was no exception, but Ed N5EM offered a new twist. He suggested doing a QRP Field Day, satellite rigs included.

The original plan was to build a large array of satellite antennas. This would give back some of the gain lost by the move from 100-watt amplifiers to attenuated, 5-watt transmitters. The antenna project wasn't ready in time for Field Day, but a pair of the large KLM antennas was made available at the last minute. Some participants felt that the task of running QRP with a normal antenna system was impossible during Field Day. Some amplifiers were brought along as back up.

Setup started late due to delays of the ferry boat from Galveston, Texas, across to Bolivar peninsula and Fort Travis Seashore Park. N5EM finally made it on the air 45 minutes after the start of the event. A-O-10 provided some difficult contacts, but the 5-watt signal was being heard.

It was soon discovered that stations that sounded too loud on the satellites were probably not hearing very well. Portable operation with noisy generators and many nearby transmitters make weak-signal satellite work difficult. Weaker stations away from the center of the transponders were better candidates for possible contacts.

Operation through A-O-13 turned out to be the best. The satellite was visible to most U.S. hams in the early hours of Sunday. Signals were good and stations were plentiful. Mode S was lightly populated, but three stations successfully copied the low-power signals from N5EM uplinked on 436 MHz and downlinked on 2400 MHz. A small Bob Myers Communications dish fit nicely in the KLM array, and worked quite well in conjunction with a German downconverter from TGN Nachrichtentechnik GmbH.

For the 9600-baud digital satellites, the low-power operation became a problem. During normal daily activity it is often difficult to get in the queue for file downloading. The 5 watts on the 2 meter uplinks for UoSAT-OSCAR-22, KitsatOSCAR-23 and -25, rarely got through during the crowded event. Many Field Day files were still downloaded with only a few successful requests for new file starts and hole fills. Uploading a complete greeting message was worse. Only one greeting file was sent and logged into the directory of a digital satellite. Yet at five points each the pursuit of downloaded and uploaded Field Day files was still worth the effort under the AMSAT rules.

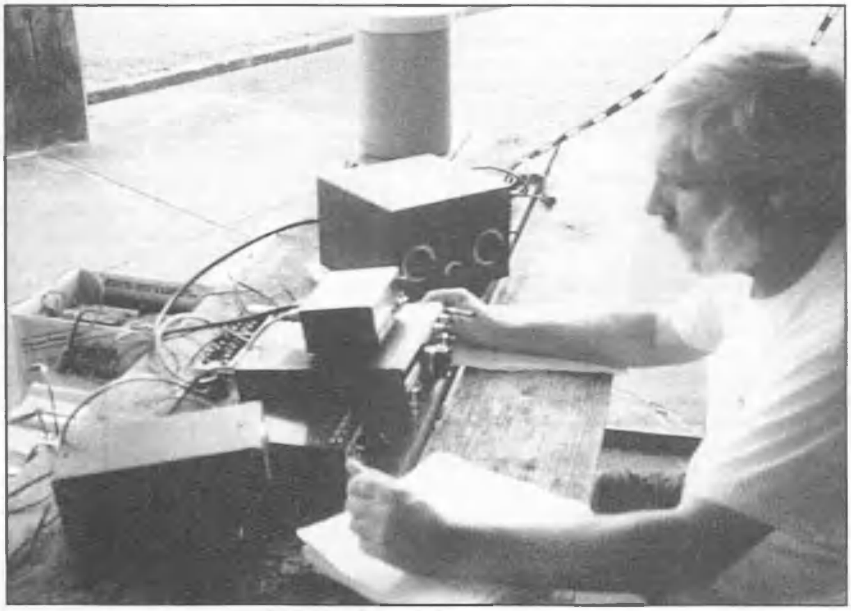


Photo A. Ed N5EM working the low-power HF Field Day station.

The Dark Side

While many have argued for a change to the ARRL Field Day rules to acknowledge the changes in the satellite world, there is still a problem. Increased activity on the birds can be damaging to the satellites. The heavy load of continuous use can put a strain on the batteries, and as the available transponder output power is shared among the users, individual signals get weak. Some users then increase uplink power levels to get better returns, thus knocking out the QRP stations and making the transponder load-

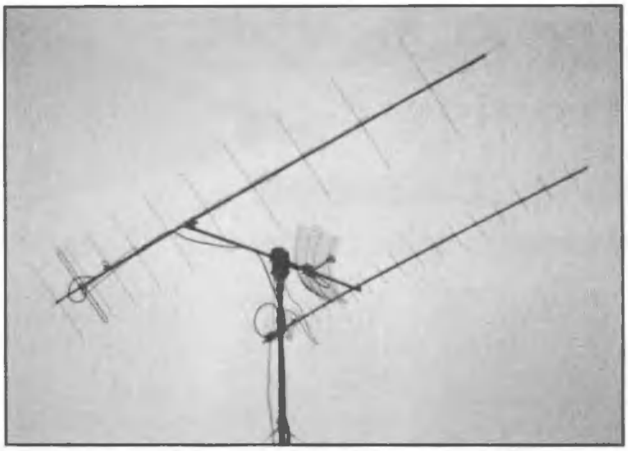


Photo B. Two large KLM crossed Yagis and a Bob Myers Mode "S" dish for Field Day satellite work.

Photo C. The hamsat station at N5EM was ready for everything from Mode "K" through Mode "S," including 9600-baud digital activity.

ing even heavier. On the low-orbit RS satellites, crowding became so fierce this year that contacts were impossible for some. AMSAT rule changes next year are likely to promote QRP, but a wait-and-see attitude might be best for any ARRL modifications.

Future Field Days

Even if the high-orbit Phase 3-D satellite is launched prior to Field Day next year, it will probably not be available for contest activity. A long check-out period will be necessary, and the changes to get to the final orbit may take as long as a year after initial orbital insertion. But when the new satellite is usable for contest events, it will be fantastic. The N5EM QRP station of 1995 will be more than enough to keep up with the rest of the field. Signal levels will be at least 10 dB better on all bands. Mode S will be a common mode rather than the exotic experiment it is today, and the experimenters will be checking out their 10- and 24-GHz systems. Camera tripods with little dishes and short Yagis may be the rule for Field Days yet to come.

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

A Kit-Built Low-Frequency (0–2 MHz) Sweep Generator

In a past column we looked at the Boyd Electronics (1998 Southgate Way, Grants Pass, OR 97526; 1-503-476-9583) RSG-30 high-frequency sweep generator. A sweep generator is a signal source that will sweep over a range of frequencies, rather than sit at just one frequency. It is used to test any resonant or passband circuit (indeed, any frequency-selective circuit) by displaying its bandpass characteristics on an oscilloscope.

The Boyd unit previously tested was available in kit form or ready-built, and tuned in the range 2 to 30 MHz. At the time, I wondered why there wasn't a low-frequency model. The reason is that many IF filters and other resonant or bandpass circuits operate in that area. The Boyd Electronics Model RSG-2 answers that need: It tunes from 0 to 2,000 kHz (0–2 MHz).

Boyd supplied me with a copy of their kit-built generator. Although the signal generator is also available ready-built at a somewhat higher price, I make it my policy to do the kit form in order to judge its complexity for readers. The Boyd RSG-2 (and RSG-30) can be easily constructed by anyone with ordinary electronic workbench skills—even beginners, if they follow instructions.

Figure 1 shows the "macro" block diagram for the Boyd RSG-2. It consists of two printed circuit boards. The mixer board contains a double-balanced mixer, a fixed-crystal oscillator, and a voltage-controlled oscillator (which supplies the sweeping action). The sweep board generates a sawtooth waveform and a synchronization pulse to trigger the external oscilloscope.

The sweep board also contains three controls: FREQ, SWEEP, and WIDTH. The FREQ control sets the center frequency of the sweep (or the exact frequency in the CW mode); the SWEEP control is a three-position switch that selects the CW, VIDEO, or SYMMETRICAL output modes (described below).

Figure 2 shows the internal block diagram in somewhat more detailed form. The crystal oscillator/mixer board contains five main elements: voltage-controlled oscillator, crystal oscillator, double balanced transconductance cell mixer, a low-pass filter, and an output buffer amplifier. The voltage-controlled oscillator (VCO) is a transistor variable frequency LC tuned oscillator in which the part of the capacitance that sets the frequency is set by an MV-1662 variable capacitance ("varactor") diode. Changing the voltage applied to the VCO IN point causes the frequency to change. If a sawtooth waveform is applied to VCO IN, then the frequency will sweep from a low frequency linearly up to a high frequency, and then snap back to the low-frequency end.

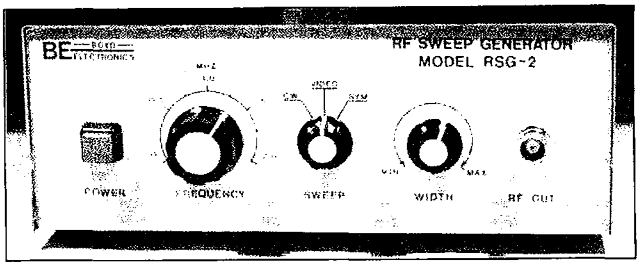


Photo A. RSG-2 as-built.

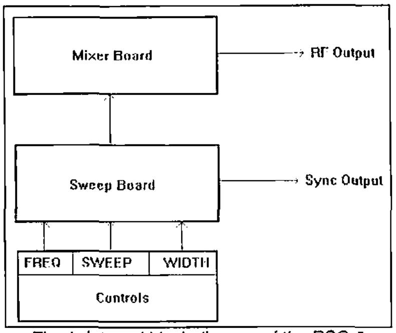


Fig. 1. Internal block diagram of the RSG-2.

The crystal oscillator and mixer are provided from an NE-602 integrated circuit. The crystal oscillator is a 5-MHz oscillator that uses the NE-602 internal oscillator stage. The output of the VCO is applied to the RF input of the NE-602. The output of the NE-602 is passed through a low-pass filter that removes any signal above 2,000 kHz, and then the signal is passed to a buffer amplifier before it goes to the output.

RSG-2 Operating Modes

The RSG-2 sweep generator has three different output modes: Continuous Wave (CW), Video, and SYM (SYM). The continuous wave output is the same as any other RF signal generator. It produces a fixed amplitude RF signal that can be tuned over the range 0–2,000 kHz by turning the FREQUENCY knob.

The VIDEO mode sweeps from the lowest frequency to the highest frequency (0–2,000 KHz). The FREQUENCY control has no effect in this mode, and the WIDTH control only affects the highest frequencies.

The SYM mode allows the sweep to center around the frequency set by the FREQUENCY control. The WIDTH control varies the sweep magnitude about the frequency set by the FREQUENCY control. The sweep width in this mode can be set from 5 kHz to some higher bandwidth. It is the SYM mode normally used to check filters, IF amplifiers, and the like.

Construction

Like its earlier cousin the Boyd RSG-30, the RSG-2 is built inside of a Radio Shack 270–274 cabinet. Boyd offers versions of the kit with and without the cabinet so that people who want to use their own favorite cabinet are accommodated. Photo A shows the RSG-2 unit that I built, while Photo B illustrates the internal works of the project. Note that the interconnecting wires between the printed circuit boards, and between the boards and the front and rear panel components, are

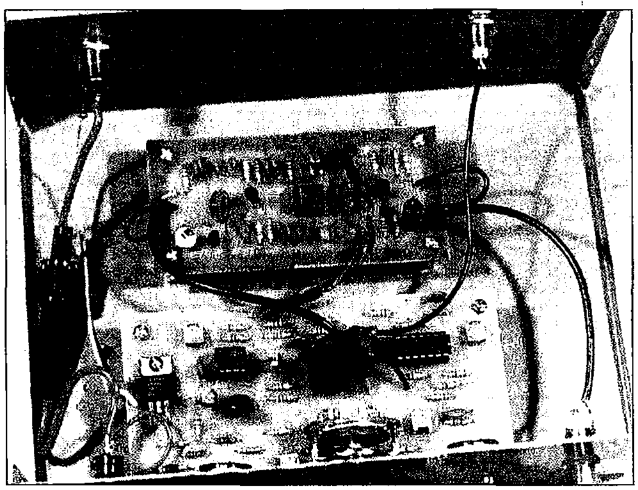


Photo B. Internal view of the RSG-2.

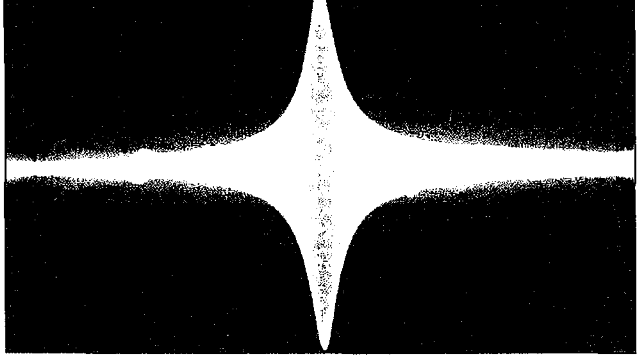


Photo C. Output waveform of the RSG-2 when passed through a 455-kHz IF transformer.

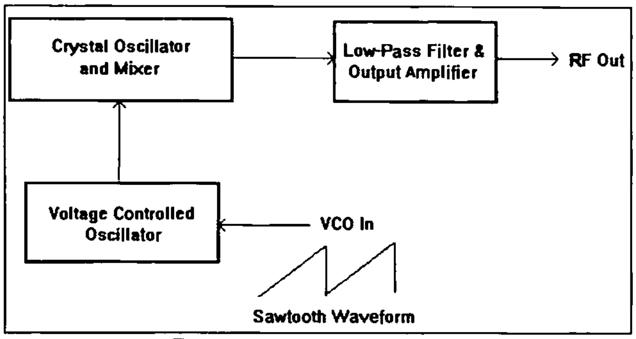


Fig. 2. A more detailed block diagram.

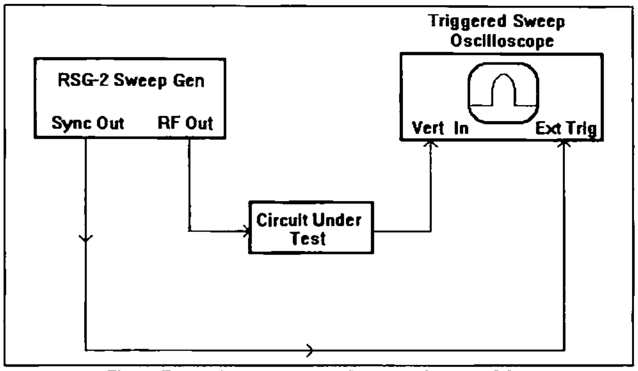


Fig. 3. External connection configuration for the RSG-2.

precut by Boyd, and so are very easily installed, even by novice builders.

Photo C shows the output waveform (this one taken using a 455-kHz IF transformer as the circuit under test). Note that it has both positive and negative peaks. In practice, the baseline would be placed at the bottom edge of the oscilloscpe, so only the positive peak shows.

Connection to Circuits

Figure 3 shows the connection of the RSG-2 sweep signal generator into a usable configuration. The display unit is a triggered sweep oscilloscope. Given the low frequencies involved, nearly any old clunker of an oscilloscope will work quite well, and possesses little or no advantage over the modern 50- or 100-MHz bandwidth models currently on the market. A coaxial cable from a BNC connector on the rear panel of the RSG-2 connects the SYNC OUT to the external trigger (EXT TRIG) input of the oscilloscope. When a pulse is received at the EXT TRIG input, the 'scope will initiate a single sweep of the horizontal time base. Because repetitive pulses are sent from the RSG-2, the sweep is continuous.

The RF OUT of the RSG-2 is connected to the input of whatever circuit or device is being tested, while the output of the circuit being tested is connected to the vertical input of the oscilloscope.

My conclusion about the RSG-2 is the same as as that regarding the RSG-30 reviewed earlier in this column: It's a darn good, handy thing to have in any electronics workshop, especially a ham radio workshop where RF circuits are being tested or developed. Normally, sweep generators are beyond the means of most amateurs, but the RSG-2 and RSG-30 make them available to nearly everyone. Write to them at the address at the beginning of this column for further information about their products.

Antlers for Windows Software

If you own a Windows computer, then you might want to use the Antlers for Windows 2.00 software for calculating antenna lengths. It is available from me for $30 (P.O. Box 1099, Falls Church, VA, 22041). Comments, questions, and requests for future topics can also be directed at me at that address.

RTTY LOOP

Number 19 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21200

In most parts of the country, unless your local school district is on some kind of trimester system, September brings the return of children to school. With that joyous event always seems to come the need to respond to your questions. So, let me roll up to the keyboard, and see what's in the IN box.

Terry Perrault, R.N., WA6MVV, of Retsil, Washington, writes: "I am a retired male nurse and have been interested in RTTY since the early years, (originally) with Model 15s and 32s. I finally broke down and got into computers. Guess I am a holdout, because I still like ARC-5 gear. Anyway, I don't know what to get.

"Sure would like a hint. Don't have much money, but maybe you could give me some hints on some older but usable gear, and a source for same. Of course, in the 'old days' you built a T.U. using a 5763. Can't do that any more, I guess! I would just love to get on HF RTTY. It's been a lifelong dream, and I don't want my dream to go away."

Well, Terry, as I have stated here, before, about any transmitter and receiver that is good enough for sideband operation is good enough for HF RTTY. That means that if you have a station, use it. If not, ask around at the local ham club, radio supply store, or even Radio Shack to see if someone has an old transmitter and/or receiver to sell.

Presuming you get that far without a problem, the computer will be your next hurdle. Here, again, you don't have to go fancy. Just about all of the basic RTTY programs, such as the ones included in the RTTY Loop Software Collection, will run on a simple 8086/8088 computer. This is the basic "XT" compatible that so many computer users are dumping as they upgrade to newer and faster machines. If you ask around, you may be able to get such a machine for a song, or maybe a song and dance. Even if you went out and bought a new machine, for RTTY it does not have to be the most expensive number cruncher in the store.

All that is left is interfacing the two together, and here you have two choices. You could use a hardware interface box, such as the Kantronics KAM, AEA PK-232, or other such controller, to handle both transmitting and receiving with a minimum of software requirements. These boxes are, in essence, RTTY modems, which can run with simple communications programs on the computer or dedicated RTTY controller programs which exploit all the bells and whistles of the hardware. Alternatively, you can use a strictly software solution, where your computer does all the hard work of converting digital pulses to tones and back, using only a simple one or two chip interface to actually bridge the hardware together. One of these solutions is the popular Baycom program, which is in the Collection as well. Drop me a self-addressed, stamped envelope, or E-mail a request, for the latest listing of programs in the RTTY Loop Software Collection.

At any rate, with some frugal shopping, and especially if you have a few good friends, it shouldn't cost you much at all in the way of hard cash to get onto RTTY. Now, as to the time involved, that's a different story. At least you're retired! Let me know how things work out for you.

Yuan-Ying Chang, KE6LTH, dropped me a message over the Internet saying:

"Hi! I am a *73* magazine subscriber. I would like to thank you for providing the schematic for BAYCOM. It's very helpful for a lot of RTTY operators. I tried to build the board a few years ago, but could not find any source for the IC 3105. By the way, because I couldn't find the TCM3105, I used the AMD7910 as a replacement. It works fine, except that it needs external DC power."

I appreciate the remarks, Yuan-Ying, especially with regard to the chip substitution. I have looked around a bit in the catalogs at WA3AJR, and don't readily see the TCM3105, either. Any readers with sources are invited to put their two cents into the pot.

Hopefully, the material presented last month on using a sound card on RTTY will speak to questions received this month from Steve Carlisle VE7AHL, who expresses interest in any material in that regard; and from Phil Reid WB7OZE, who notes that the SoundBlaster sells for less than $100 in the Pacific Northwest and it has the hardware onboard, including DSP, to do the job.

As detailed last month, about all of the material I have located is for the Cardinal flavor of sound boards. For some reason, the SoundBlaster brand is not well represented here. One presumes, as detailed last month, that the programming is more straightforward on the other boards. This is not to say that it cannot, or has not, been done with the SoundBlaster, I just have not seen any of the results. Will keep at least one eye open for this one, though.

James Thomas drops a note from Taiwan, in which he says: "I was in the local bookstore and found a story written by you in *73* magazine and you were chatting about a program called XPCOM. Well, I think I have a related problem that I hope you can help me with. I just got my hands on an IC-7100, IC-R72, and CT-17 interface controller from Icom and I can't find a program in Taiwan or on the Internet that will allow me to use the Icom CT-17 to control my two Icom radios via the computer. Do you have any leads on where on the Internet I could find a program that can use the CT-17 to control the radios?"

Well, James, I looked around, and about all I found was a file detailing modifications to and features of the Icom IC-7100 receiver. You might try looking at ftp://fpt.qrz.com/mods for some of these modification files.

That URL, by the way, is the file server of the QRZ Home Page, which can be found on the world wide web at http://www.qrz.com. This is a very useful little page on the Web which, among other things, supports a rather nice set of programs, including a call book lookup. If you access your own call book entry, you can even put in an E-mail address, to facilitate users finding you. Since spots of interest on the net are rapidly becoming one of the more common requests received here, I will try to tell you about one with each new edition of RTTY Loop.

Meanwhile, I look forward to your comments and questions, as usual, by any of the common means. Feel free to drop me a line at the above address, or via E-mail on CompuServe (75036,2501), Delphi (MarcWA3AJR), America Online (MarcWA3AJR), or on the Internet (MarcWA3AJR@aol.com). Who knows, maybe a RTTY Loop Home Page will be on the Internet in the future, as well!

QRP

Number 20 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

A QRP Receiver That's Easy, Simple, and Effective

I wanted to use this month to finish up some of the smaller projects for the NN1G Small Wonder Labs transceiver. But, alas, time did not permit me to get all the circuits tested. So look for those projects in the coming months.

Instead, let us look at a simple receiver for the QRPer. Just about anyone can sit down with soldier iron in hand and build a QRP transmitter. Whipping up a receiver that works is an entirely different subject. Well, there is now some good news from the folks at Ten-Tec. The Model 1056 Is a direct conversion receiver you can assemble on any ham band from 160 meters to 10 meters. Best of all, all the frequency-dependent components have been included. Just pick your band and stuff the PC board with the correct capacitors and inductor.

A Closer Look

The Model 1056 is based on a simple but effective design. It also sports several novel features not normally found in simple direct conversion receivers. I'll explain these later on, but for now let's look at the audio stage of the receiver.

In a direct conversion receiver, almost all of the gain is derived by the audio stage, and the Model 1056 is no exception. However, in this case, the audio stages are fine-tuned. They produce enough gain to allow the receiver to hear weak signals, but without the distortion and microphonics that plague most direct conversion designs.

If you're accustomed to the lackluster audio from most homebrew receivers, you're in for quite a surprise. Instead of the usual QRP rig audio amplifier chip, the LM386, Ten-Tec designed the Model 1056 around a hybrid audio amplifier. The BAH packs a lot of power in a single in-line package. Ten-Tec has a history for excellent audio designs in their transceivers. No doubt, the audio amplifier stage is an off-shoot from one of their many transceivers. The Model 1056 is one of the few direct conversion receivers that can drive an external speaker with room-filling audio.

It has a PC board-mounted jack so that you can use a set of "walkthing" headphones. You can also hardwire a speaker or audio jack if you desire. The end result is the same: The Model 1056 sounds good.

Another feature you won't find in most direct conversion designs is an audio bandpass control. The bandpass is an active audio filter ahead of Ihe audio power amplifier stage. It gives the user a small degree of control over Ihe bandwidth of the receiver. This control works in the AUDIO section of the receiver and does not affect any of the RF stages. It seems most effective while tuning in a SSB QSO. The bandpass is not a sharp audio filter for CW. It does improve CW reception, but don't think of it as a QRM cure.

But, there are still more features found in the 1056's audio stage. You can easily inject a low-level sidetone directly into the audio stage. This is great if you're thinking about using the Model 1056 as a beginning for a single-band transceiver.

Along with sidetone injection, you can also mute the audio stage. Again, this is a slick feature for those wishing to roll their own transceiver.

The RF Side

Here the Model 1056 is rather generic. An NE602 is used as a mixer and VFO. Incoming signals are mixed inside the NE602 and then routed to the audio stages. This is classic direct conversion design.

The VFO is varactor tuned with a PC board-mounted pot. In my review unit, I had coverage from 7.000 all the way up to 7.300 MHz. The tuning is very fast. But wait! To make tuning usable, a technique from way back when is used. It's called a bandspread control. In this case, it makes tuning the band enjoyable. As the Model 1056 is designed to be played with, I would start changing values in the circuit to improve the tuning range. A 10-turn pot could easily be installed to really smooth out the bandspread.

The band on which you operate the Model 1056 will determine the components used in the VFO circuitry. There are no coils to wind. I found setting the VFO to the desired frequency easy to do with a frequency counter. Ten-Tec makes this easy to accomplish because they have included the necessary components to pick off some of the VFO's output. It's a nice touch to include in the design!

The front end includes a tuned input circuit for the band being used. A brute-force RF-gain control provides some means of controlling front-end overload.

Building the Model 1056

All components for the PC board are supplied from Ten-Tec. This includes all the components used for all the bands on which the Model 1056 will operate. You end up with a lot of extra parts and pieces when you're done! Add 'em to your junk box, or change bands when you get tired of the one you're on.

Everything mounts on one single-sided PC board. This includes the speaker jack, RF gain, main tuning, bandspread, bandpass, and volume control. The PC board has a top silk screen, but the foil side is not plated or reflow solder plated. All the PC board-mounted components fit the board, including the disc capacitors.

Assembly starts with the audio sections. You assemble the audio power amplifier and bandpass section. Then apply power to the receiver and do some simple checks. If this stage is working, you then proceed to the RF section.

The assembly manual Ihat Ten-Tec provides gives you plenty of information on how to put the kit together. It's not overly detailed, but does use the "install part and check off" procedure. Such things as the polarity of electrolytic capacitors are clearly explained. Ditto for diodes and the ICs. It's about a clear as you can make it.

Adjustments and Alignments

Since a direct conversion receiver lacks an IF stage, the only adjustment you have to do on the Model 1056 is to set the VFO to the proper operating frequency. The best method is to use a frequency counter. If you lack one, you can press a general coverage receiver into use. Listen for the VFO and adjust it to Ihe operating frequency desired.

With the VFO set, and providing the band you selected is open, you'll hear stations. I always choose the 40 meter band, as there is something on it 24 hours a day.

Operating Notes on the Model 1056

With such a simple circuit, it's amazing what it can hear. If I could hear it on my Argosy, the Model 1056 was able to detect it as well.

As I mentioned earlier, there's plenty of audio. This is one direct conversion receiver in which you won't have to run the audio gain all the way into its stops just to hear some band noise. The bandpass control works as it should and does help with some stations. I get the most use oul of this control when listening to SSB.

The tuning and bandspread controls work together. You will do most of your tuning around the bands with the bandspread control, leaving the main tuning in one spot.

I did notice some AM bleed-through on 40 meters at night. I suspect two causes: I was using a multiband vertical antenna; and I did not reduce the RF gain. After playing with the rig for awhile, you can adjust the RF gain and audio gain controls to almost eliminate AM bleed-through. Using a single-band antenna would be a major factor in preventing out-of-band AM signals from reaching the Model 1056.

Of course I tested the rig with it just laying out on the desk. It held its own in terms of frequency stability. However, to really make it stable, it needs to be mounted in a secure enclosure. This is a *must* if you plan to use the Model 1056 on any band above 30 meters. The reason is simple. A direct conversion receiver as simple as this runs the VFO at the operating frequency. At 10 meters, the on-board VFO will be running at 28 MHz! So consider investing in a solid, all-metal box.

The Model 1056 is a great little receiver. You can't beat it for the money. It does what it says it will do and more, and would also be a great club project. The circuit provides enough features to let you listen to the world, without killing your budget. No matter if you're a seasoned QRP builder or a newcomer to the hobby, the Model 1056 will not disappoint you.

Never Say Die

Continued from page 4

Say, if you find out about anything in the health field you think I'd be interested in, send me a clipping or the name of a book you recommend I read. And I'll be reviewing some great books I've read recently for you.

Having been fat, I know all about the problem. I had a 44 waist for years. It's been 36 for the last 20 years, ever since I decided once and for all to take off the crummy fat and stay normal. I'm living proof that it can be done, so I'm not asking anyone to do something I haven't done. Another *been there, done that.* And, yes, I exercise every day, no matter where I am. There I was at 6 am jogging along the streets of Hong Kong, Beijing, Taipei, Osaka, Tokyo, Seoul, Kuching, Bangkok, Kota Kinabalu, Macao, Manila, Monaco, Paris, London, Mbabane, Maseru, Nairobi, Amman, Bahrain, and New Hampshire. The next "world" may be a great place and all that, but I intend to stick around here as long as I can . . . and do my best to keep you here with me. We can get together for a rag chew in heaven, where time runs on a different clock, and I'm not trying to get so much done in what little time I have left.

Meanwhile, there's a lot you can learn, and endless opportunities to explore and pioneer new ideas and technologies. Remember, most of the really important break-throughs in science have been made by amateurs. Or did you miss the great article in issue #1 of *73* by John Campbell W2ZGU, back in October 1960?

Good grief, I've been at this for 35 years!

Special ARRL Discounts?

A letter from Ivan N4EYQ really surprised me. He explained that as a handicapped ham he was getting a special $6-a-year membership and subscription from the League. Wow! I think that's very humanitarian of them to offer such a bargain, though it could turn out to be illegal if challenged.

Does anyone know what limitations the ARRL has put on this special rate? To what handicaps do they apply? Ivan is legally blind (20/200 or worse), but it seems to me this subscription rate would probably apply to hearing-impaired hams, too. We've had some mover-and-shaker hearing-impaired hams. Bob Weitbrecht W6NRM comes to mind. He and I made the first coast-to-coast 80m RTTY contact one night awhile back. We also worked on 11m, back before our lack of use of the band prompted the FCC to turn it into a CB band. Well, I warned everyone at the time in my editorials, but I just got called a doom and gloomer. I got the same from the old-timers when I warned that we could lose part of 220 if we didn't use it. I've still got some "220—use it or lose it" buttons I was distributing at the time.

We've had some wonderful contributions to the hobby by blind hams. I'll never forget Stan W2ER, who built and serviced all his own equipment. Or Bob Gunderson W2JIO, who published the Braille Technical Press for years.

But how about hams on welfare or unemploment compensation (job-challenged)? How about the substance-abuse disadvantaged (drug addicts)? How about our poor old seniors trying desperately to get along on their social security pittance (age-challenged)? Or is it social insecurity these days? How about our disabled military veterans? How about all of our physically challenged hams?

For that matter, how about poor old Uncle Wayne? No, I'm not blind, but I am disadvantaged and multi-challenged. I'm struggling to get along on my social security and a veteran's disability pension. I'm too old and decrepit for anyone to consider hiring me any more. Shouldn't I qualify?

Repent! The End of the World Is Near!

Fasten your seat belt. This is going to be a direct attack on contests. Yes, I recognize that I'm getting into a theological discussion. I suspect that the prefix "theo" means "il" or "non," because as soon as religion gets involved, logic has little more to do with things. Or reason.

Okay, now let's make at least an attempt to put on your thinking cap. Now, doing your very best to think, what is by far the biggest contest in amateur radio? I remember one ham (the last I heard he's in prison) who bragged that he was making over $50,000 a year in completely untaxed income just by cheating at this contest. I checked on this myself in several countries and I don't think he was exaggerating.

What one contest has forced more hams off the air than all the rest of 'em combined? What contest has generated more anger and resentment with US hams by foreign hams than all the others combined? Either you know the answer or you need to get your thinking cap refurbished.

One more chance: what contest requires the greatest investment in ham equipment just to participate?

Of course I'm talking about the ARRL's DXCC contest and their accursed Honor Roll listings.

Whenever I visit a relatively rare country, I find the local hams furious over what this has done to them. Every time they get on the air they are besieged for 15-second contacts and a QSL. Now you may think it's fun to sit and fill out thousands of QSLs every month, particularly if you have to look up each contact in your log to check it. That's when you find that a surprising percentage of US hams have no idea of what GMT is, and many have apparently even lost track of the date.

Only by calling stations who have called CQ, and by giving their own call a minimum of times, can they manage to make any real contacts. As soon as the word gets around the 2m DX-chasing nets, they are bludgeoned into contest-type operation or, as is more usual, forced off the air.

When I'm going to be visiting a rare country, I ask a local ham if I can use his station and promise to take care of the QSLs I generate. They know that this will tend to ease the pressures for him in the long run, so I've never had anyone refuse. It really isn't fun for a DX ham to be stuck with endless contest-type contacts. It's difficult enough in many of these countries to get a ticket, and then getting the rig is even harder. And after all that, the hams won't let you have a decent conversation because they "need a new country for DXCC."

When I first went to Jordan, my main aim was to work as many DXers as I could so that His Majesty would have a little less pressure to just give signal reports and send a QSL card. I spent a couple weeks working the pileups from his Summer Palace, just outside of Amman. I worked thousands upon thousands.

I've done the same thing from dozens of other rare spots. Well, it was fun for me, but if I were living there, I know it would get old. For that matter, I guess it's gotten old for me. My last real DXpedition was several years ago to St. Pierre. More recently, when I visited 11 Caribbean islands, I didn't bother to take a rig or arrange to borrow one. I did get on the air from a few islands, but only for a few contacts. Mostly around the Caribbean.

Basis And Purpose

So, if we're not going to be needed for emergency communications, and hams no longer are of the slightest interest to the military in case of war, what might be our new reason for having the use of billions of dollars of spectrum? Yes, it's a wonderful way for retired old white men to spend the time during which they aren't playing golf. But is that of more value to the country than leasing our ham spectrum to commercial companies and using the revenue to retire the national debt?

I'm proposing as a new basis for the hobby a goal of using it as a way to make high-tech careers more interesting for our youngsters. It sure worked in Jordan, where I was able to introduce that concept. It could work here, if we could get the ARRL to make some desperately needed changes to make hamming more attractive to kids. Yes, it's that code thing. But it's also our need for promotion, publicity, and even some advertising. Most kids have never even heard of amateur radio. Is it something like CB? Yeah, kid, now get away and stop bothering me.

We know that the vitality of America lies in the education and skills of our workforce. We know that an ability to cope with and use technology has a high priority. So here we are, with the worst and most expensive school system in the world, and with less than 10% of our high school graduates even able to cope with an engineering college. I've done my homework on all this in my work on the RPI Council and the New Hampshire Economic Development Commission, so I'm not exaggerating.

I keep preaching the need to get our schools to institute an eight-year course in electronics, communications, and computers, in grades 5-12. And as part of that we would encourage the kids to get into hamming so they'd be learning because it's fun, not because it's another class in school where all they have to do is pass the final test and move on, forgetting at least 90% of what they learned.

We need five million hams instead of 500,000. How about 50 million? You say that might tend to crowd our bands? Let me remind you that at present we're actually using less than 3% of our assigned spectrum. With ten times as many hams we might expand that to 30% usage. But we might also encourage the development of more spectrum-efficient modes. We know we could get a hundred times as much information exchanged in the same bandwidth with already developed data-compacting techniques.

Bringing in kids could save our bacon. Up until 1963, when the ARRL bombed the hobby and the industry with their infamous and deceptively-named "Incentive Licensing," 80% of all new hams were youngsters. The ARRL directors, led by multi-millionaire Mort Kahn W2KR, put an end to that, as well as the US dominance of the ham manufacturing industry.

Repent! The end is near!

Another Ooops, But Not Mine

The Navy has been busy assuring home owners near their Extra Low Frequency (ELF) stations in Upper Michigan and Cape Cod that these radio waves won't have any effect on them. Thus a new report from the Michigan Technological University may send Navy officials scurrying to

handle damage control.

Il seems that these "harmless" radio waves that are used to communicate with submarines are causing up to 50% faster growth of several kinds of trees in the vicinity. Particularly affected were aspen, red maple, and red pine. Now, if radio waves can do that to trees, what may they be doing to the cells of people in the vicinity? We don't know how our cells know where they fit into the body's architecture, but each cell seems to have a blueprint for the whole body and know when to be replaced and by what. We know from the work of Ross Adey K6UI that radio frequency fields can screw up this system, causing serious problems.

I know that if the Navy wanted to put one of the ELF installations anywhere near my home, I'd fight it in every way I could and then, if I lost the battle, I'd move the heck out of there. There are enough outside influences knocking down my immune system without adding one more. And I say that as a veteran submarine electronics technician and thus well aware of the need for submarine communications . . . and of the difficulties involved in getting through to submerged subs.

Whadaya read?

If you count up the total paid circulation of all three ham magazines, and even if you don't figure any overlap of readers at all, less than half of all licensed amateurs are bothering to read any ham magazines!

Now, is this because over half of us have no real interest in the hobby, or is it that perhaps the ham magazines are unappealing? And that might even include *73*, since over 500,000 licensed hams are not reading it.

I suppose that to the essentially brain-dead who are merely logging call letters, handles, and signal reports, who have no interest in any information about other ham activities, are satisfied with their rig, and couldn't care less about any new equipment coming out, there's no need to read a ham rag. Ditto those who are spending their remaining days on one or two local repeaters. The whole idea of getting on packet or making satellite contacts is so far beyond their conception that magazine space devoted to these activities is irritating.

The next time you're on the air, start asking the chaps you contact which of the ham magazines they read. Ask them which they enjoy the most; which they've found helps them learn more about technology; which has inspired them to try some new ham activity. Please keep track and send me a copy of what you've discovered. I want to know what I'm up against. Or whether I should just give up trying to get hams enthused about our hobby and go on a long vacation and DXpedition.

Beyond that I'd appreciate it if you'd take a good critical look at *73* and let me know how it shapes up for you on the above questions. We do have far more reviews of new products than the other ham rags, but maybe you haven't noticed. It's fun to get something new now and then, and our readership surveys always show a top interest in reviews. We tend to steer away from heavy contest coverage, even though I used to enjoy them. *CQ* is so totally devoted to contests that I leave that niche to them.

How does *73* rate in comparison with the others? Going by my mail, it seems that it rates highest with most readers. But then, if I'm going to attract more readers I've got to know where *73* really stands.

The magazine was doing very well when I was forced to sell it to IDG a few years ago. When I sold all of my computer magazines, I had to sell the buildings that went along with them, plus all of my publishing equipment. That left me with no way to produce *73*. Oh, they said that they wouldn't make any changes and that they wanted me to continue my editorials. But as soon as the ink dried on the agreement, I was out. They didn't even tell me about it; I had to find out by reading the local paper. It took me almost a year to build a new publishing business so I could start *Digital Audio*. Meanwhile, *73* just about fell apart under the new management. It lost half its circulation and half its advertising, and was heading for the pits when I finally got it back.

By then I was deeply into the music business, publishing *CD Review, Music Retailing,* and *IMPS Journal*. Plus I had a couple record companies, a recording studio, and a few other ancillary businesses. That kept me from really concentrating on rebuilding *73*'s circulation. Now that I've sold most of my music publications and businesses, I'd like to get *73* back to being the biggest of the ham rags. And that means getting more readers. More readers will attract more advertising, and for every page of ads we can run an extra page of articles for you.

So see what you can do to find out why about 90% of the hams are not reading *73*, and let me know. What do I have to do, start a national ham organization and run 20 pages or so of club news every month? I'd rather get hams doing more things,

and maybe even thinking now and then. It's kinda fun.

What You Can Do!

I've probably been boring you with my constantly urging you to get kids involved with amateur radio. Presumably you agree with me that unless we make some headway with attracting kids, we could easily lose everything. The old basis and purpose for our government-supported hobby have been mostly blown away by changes in technology. Well, we don't want to be in the same position with amateur radio as workers are who have not developed new skills to cope with technological changes. Hey, I've been doing the same job for years and now I've been fired!

So yes, there is something that you can do that will help. As I've mentioned, when I give talks on entrepreneurialism at schools and colleges, I always ask for a show of hands of those who know about amateur radio. I see very few hands. With no organization to get us PR, the result is very few newspaper or magazine articles, and almost nothing on broadcast radio or TV. The ARRL apparently doesn't want to spend any of those millions they've socked away to hire a PR person to help promote the hobby. The directors seem to feel that our bands are already too crowded, so who needs more hams?

One simple way to help kids know more about hamming is to make sure that their school libraries have subscriptions to *Radio Fun* and *73*. For $30 you can endow your local school library with a year's subscription to both publications. And how about your local public library, too? Libraries are underfunded, so they need help with magazine subscriptions. Make out a check to *73* magazine or provide your credit card number and the address of the school libraries you wish to endow with subscriptions. We'll start the subscriptions and send a letter informing the principal of the school of your gift, suggesting it be posted so the students will be aware that the magazines are now available in their library. Even if your subscription only gets one youngster into amateur radio, it'll be a wonderful bargain for you.

Paying The Freight

So here we are, having fun making our ham contacts—around town via our repeaters, around the country, and around the world. We're having a ball with packet, RTTY, slow-scan, ATV, ham satellites, and so on. Of course, unlike some other countries, we don't have to pay anything for the use of our ham bands. I guess we figure that as Americans we have some sort of birthright to them. And we also believe we have the right for our government to pick up the tab for what it costs to keep our fun going. And that they should also act as policeman, judge, and jury when we have any problems.

You know, when I got into hamming, back almost 60 years ago, we were paying our way with services to our country. Our country got a huge payback when WWII came along, and never mind any benefits we'd provided in emergencies. We had about 50,000 licensed hams at that time and our average age was in the high 20s. Eighty percent of the hams joined the armed forces and we contributed very significantly to the war effort. I was there. I joined the Navy and went to their electronics schools to learn about the Navy radio, sonar, and radar equipment. Their schools were superb. Most of my instructors were hams, as were many of my classmates, and we Radio Technicians (RT-3/c) had no problem in learning how every circuit of the Navy receivers, transmitters, sonar, radar, and test equipment worked. Thus we were able to quickly fix anything we might run into.

Of course in the 1930s we hams had to build and service our own rigs. We bought our receivers, but we had to fix them ourselves. Now most of us buy everything and send it back to the factory when it breaks. How many hams do you know who can help you fix your synthesized transceiver if it conks out?

Amateur radio, as you know, has changed. Few hams build anything but kits now. Almost none of us are able to fix a broken rig. Where in the 1930s hams were years ahead of the military in equipment design, today we are hopelessly out of touch with the state of the communications art.

When I went to work for GE during the summer of 1941, testing their BC-191 and BC-375 transmitters, I couldn't believe how seriously outdated the design was. When I checked, I found the design had last been modified in 1935.

While it seems unlikely that we'll ever have to gear up for another major war, we hams would have almost nothing to offer if one occurred. Our value to the military is obviously no longer a valid reason for our government to spend millions of dollars maintaining our hobby. Nor is our vaunted ability to copy the code.

I'm old enough so I can remember when we used to be in the forefront of radio technology. We pioneered FM, NFM, SSB, SSTV, and so on. Well, those laurels withered away years ago. Now I see hams pushing

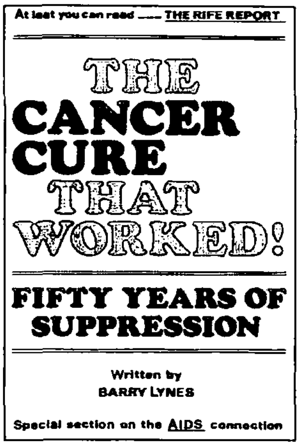
to keep the code test as a barrier to new hams, knowing that the code hasn't been of any real use to the military for almost 50 years. And one look at the technical articles in the ham magazines today would show any engineer that we are years behind today's technology. Is there a term for reverse pioneering?

With Congress looking for every possible area to cut government expenses, what would you say to a congressional committee in support of the FCC's expenses for maintaining our billions of dollars of ham spectrum, the costs of licensing, and monitoring? Would you say, "Look what we did for you 50 years ago"? And if their support staff has done their homework for them, they might point out that ham radio today is little more than a sort of retired white men's federal welfare program.

What do you propose we do about this?

Can RF Cure Cancer?

More of Wayne's baloney? Or could it be true? You're going to want to get a copy of an amazing book on the life of Royal Rife and read about a chap who invented a superpowerful microscope back in the 1920s, one that enabled him to see microbes and viruses smaller than any other microscopes could let people see, yet do it



without killing them.

Electron microscopes provide similar magnifications, but they can only let us view dead material. Rife was able to see filterable microbes and viruses as they lived and multiplied. He discovered while watching them that one particular radio frequency could resonate and blow each type apart. With this tool he was able to build radio generators which were curing cancer and many other illnesses back in the 1930s.

So what happened to this amazing discovery? It was another victim of the American Medical Association's control of the industry, and its power with the FDA. The story is that the head of the AMA demanded part of the action. When Rife refused, the FDA moved in and destroyed Rife's generators and even his microscopes!

You'll want to read about all this in *The Cancer Cure That Worked!* by Barry Lynes. It's available from Marcus Books, Box 327, Queensville, Ontario, Canada L0G 1R0. If there is enough interest, I'll see if we can stock it in Uncle Wayne's Bookshelf. If there isn't enough interest, that'll be proof to me that your curiosity has truly been killed by our school system.

As you read this 168-page paperback, you'll find that Rife discovered that microbes don't cause illness; they're the result of it. Oh well, our so-called health care system is always treating the symptoms and not the causes of illness, so what's new? And now we're seeing a renewed attack on alternative approaches to health by the FDA in cities all around the country. Please save us from our government bureaucrats.

Of course you can wait until some dread illness strikes you or your family and then wonder if your doctor knows what he is doing as he puts you through chemotherapy or bypass surgery. You aren't going to like the answer if you read much about the alternatives. Could tuning your rig to one specific frequency blast out cancer cells? Or can AIDS be cured by putting a small voltage across your ankles?

I hope you read enough to know the sorry recent history of stomach ulcers and the fight of one doctor to get the medical industry to recognize that they're caused by a microbe *(H. pylori)*. The AMA and the FDA fought him viciously for years. Now they sheepishly admit that, by golly, he was right. The New Yorker had a fine article on this, as they have on several other health matters.

If you've read about anyone else pursuing the Rife approach to getting rid of microbes and viruses, please clue me in.

Cover Photos

We need a good cover photo every month; so keep your eyes peeled for interesting ham subjects. Kids, unusual antennas, action, club activities, unbelievable ham shacks. The *73* cover requires a vertical format, with some uncluttered space on the left to list features, so keep your camera turned sidewise. You'll get pretty good shots with 35mm if you use a tripod, but a larger negative is preferred. Your pictures should be very sharp. We pay $100 or so and you get the by-line. Now let's see what you can do.

Number 21 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

SEP 16

GLORIETA, NM The Northern NM ARC will sponsor their annual Hamfest 8:30 AM-3 PM at the Glorieta Conference Center, Patio Building, 16 mi SE of Santa Fe on I-25, exit 299. VE Exams at 10 AM. Talk-in on 146.52. Contact *Helenrose Burke W5IXS, Box 73 HCR, Ojo Sarco NM 87521. Tel. (505) 689-2367*. For hotel/motel room, contact *Glorieta Conference Center, P.O. Box 8, Glorieta NM 87585; Tel. (505 757-6161.*

GRAND RAPIDS, MI The Grand Rapids ARA will hold its ARRL approved "Super Swap 95" at Unity Christian H.S., 3487 Oak St., Hudsonville MI. Setup at 6 AM; doors open at 8 AM. For ticket info and table reservations, contact *Jeff Belknap N8RWS, 454 Harp St. SE, Kentwood MI 49548*, or call *(616) 531-7899.*

PHOENIX, AZ Sixteen local amateur radio clubs of Phoenix will sponsor the 3rd annual Family Amateur Radio Event, 9 AM-2 PM at Rawhide Rodeo Pavilion, 23000 N. Scottsdale Rd. (north of Scottsdale). The Entrance is on Williams Rd. Swap Meet. ATV. Packet. Exhibits. Lots of great non-ham activities. Talk-in on 146.76. For info, contact *Len Winkler KB7LPW, (602) 861-0303*. For advance tickets, spaces, write to *FARE, P.O. Box 9219, Phoenix AZ 85068*. Please enclose SASE.

RANDOLPH, VT The Central Vermont ARC's 7th annual Fall Foliage Hamfest/Computer Fair will be held at the Judd Gym., Vermont Tech. College, 9 AM-3 PM. VE Exams at 12:30. Forums. Flea Market. Talk-in on 147.09/.69 and 146.625/.025. Contact *Barry Driscol N1NPU, RR 1 Box 3165, Barre VT 05641; (802) 479-1408*; or *Tom Girardi WA1YNU, P.O. Box 261, Waterbury VT 05676; (802) 244-7836.*

SANTA ROSA, CA Sonoma County Radio Amateurs annual Flea Market/Auction will be held at Holy Ghost Hall, 7960 Mill Station Rd., Sebastopol CA. For info/pre-reg., send SASE to *Rick Reiner, 2120 Slater St., Santa Rosa CA 95404. Tel. (707) 575-4455 (exams).*

SEP 16-17

PEORIA, IL The Peoria Area ARC will present "Peoria Superfest '95" at Exposition Gardens. VE Exams on Sun. Contact *Ron Morgan KB9NW, Chairman, Peoria Superfest '95, c/o The Peoria Area ARC, Box 3508, Peoria IL 61612-3508*. Or dial the *(309) 685-6698 answering service.*

SEP 17

ADRIAN, MI The Adrian MI AARC Hamfest/Computer Show will be held at Lenawee County Fairground, 8 AM-2 PM. Talk-in on 145.37(-). VE Exams, walk-ins accepted. Contact *Greg KZ8X, 4281 Mohawk Trail, Adrian MI 49221. Tel. (517) 263-1153.*

MT. CLEMENS, MI L'Anse Creuse ARC will hold its 23rd annual Swap & Shop, 8 AM-2 PM, at L'Anse Creuse H.S. in Mt. Clemens. VE Exams at 11 AM. Contact *Don Olszewski WA8IZV at (810) 294-1567: Prodigy ID#SSTG41a.* For info, send SASE to *Mark Castiglione N8REZ, 26279 Fairwood, Chesterfield MI 48051-3031. Tel. (810) 949-2508*. Talk-in on 147.08(+) or 146.52 simplex.

NEWTOWN, CT The Western CT Hamfest will be held at the Edmond Town Hall, RT 6, 9 AM-2 PM. Setup at 7 AM. Exit 10 on I-84. Talk-in on 147.12/.72. Flea Market. New equip. dealers. Computers. Tailgating. Contact *Ken Weith KD1DD, P.O. Box 3441, Danbury CT 06813-3441. Tel. (203) 743-9181.*

PITTSFIELD, MA A Hamfest, sponsored by the Northern Berkshire ARC, will be located at Teconic H.S. on Valentine Rd., 8 AM-2 PM. Setup at 7 AM. Talk-in on 146.91. VE Exams at 9:30 AM. Walk-ins accepted. Flea Market. Contact *Chuck Lowery N2IZ, (413) 447-8377.*

SEP 23

NEWPORT, NH CVFMA "For Sale and Trade Social" will be held at Sugar River SB Community Room, Main St., 35 mi north of Keene NH; RTE 10 and RTE 10 south I-89 exit 13 or RTE 11 west from I-89 exit 12. Setup 12:30 PM. Public 1 PM-4 PM. This event will be held after a test session. Talk-in on 146.760. Contact *Conrad Ekstrom WB1GXM, P.O. Box 1076, Claremont NH 03743. Tel. (603) 543-1389.*

SEP 23-24

VIRGINIA BEACH, VA The Virginia Beach Hamfest and ARRL Virginia State Convention will be held at Virginia Beach Pavilion. Commercial Booths: *Lewis Steingold W4BLO, 1008 Crabbers Cove Ln., Virginia Beach VA 23452; (804) HAM-FEST.* Tickets and Tables: *Manny Steiner K4DOR, 3512 Olympia Ln., Virginia Beach VA 23452: (804) HAM-FEST.*

SEP 24

COTTLEVILLE, MS The St. Peters ARC Swapfest will be held 7 AM-1 PM at St. Charles County Comm. College Campus, 4601 Mid Rivers Mall Dr., Cottleville MS. VE Exams. Talk-in on 145.41 and 444.275 MHz. Contact *Jay Underdown W0OGS, 58 Judy Dr., St. Charles MO 63301. Tel. (314) 723-4200.*

FRAMINGHAM, MA The Framingham ARA will hold its Fall Flea Market and Exams at Framingham H.S., A St. Doors open 9 AM to early bird buyers; 10 AM to all buyers. Setup is 8 AM. Table Reservations: *Lew Nyman K1AZE, (508) 879-7456*. Send check payable to *FARA, P.O. Box 3005, Framingham MA 01701*. To register for Exams, send check for $5.90, payable to *ARRL/VEC*, to *Dick Marshall WA1KUG, 37 Lyman Rd., Framingham MA 01701.* Walk-ins not accepted after 10 AM. Talk-in on 147.15/R.

YONKERS, NY Metro 70cm Network will host a Giant Electronic Flea Market, 9 AM-3 PM at Lincoln H.S., Kneeland Ave. VE Exams. To reg., call *Otto Supliski WB2SLO, (914) 969-1053*. Talk-in on 440.425 PL 156.7; 223.760 PL 67.0; 146.910 Hz; or 443.350 PL 156.7. Mail paid reservations to *Metro 70CM Network, 53 Hayward St., Yonkers NY 10704.*

SEP 30

ELMIRA, NY The Elmira ARA will present the 20th annual Internat'l Hamfest at the Chemung County Fairgrounds, 6 AM-5 PM. Flea Market. New Equip. Dealer Displays. Advance tickets: *Dave Lewis, RD1 Box 191, Van Etten NY 14889. Tel. (607) 589-4523.*

OCT 1

LIMA, OH The NW Ohio ARC will hold a Hamfest at Allen County Fairgrounds, State RTE 309. Opens at 8 AM. VE Exams, all classes, with complete FCC Form 610 and a check for $5.90, made payable to *ARRL/VEC*. Send to *Jon Solomon W8TY, 1370 Stevick Rd., Lima OH 45807.*

QUEENS, NY The Hall of Science ARC Hamfest will be held 9 AM-3 PM, at the NY Hall of Science, 47-01 111 St. Ham Radio/Computer Flea Market. Tune-up Clinic. ARRL info. For more details, call (nights only), *Arnie Schiffman WB2YXB, (718) 343-0172*; or *Charlie Becker WA2JUJ, (516) 694-3955*. Talk-in on 444.200 WB2ZZO/R and 146.52 simplex.

OCT 7

BELTON, TX "Ham Expo '95" will be sponsored by the Temple ARC, starting at 7 AM at Bell County Expo Center at 1 PM. VE Exams. Transmitter Hunt. Talk-in on 146.82. Contact *Temple ARC, 2014 S. 53rd, Temple TX 76504. Call* Mile WA5EQQ, (817) 773-3590; e-mail: 72437.424@compuserve.com *or* laird@vvm.com.

OCT 8

DURHAM, CT The 1995 Nutmeg Hamfest/Computer Show will be held at the Fairgrounds in Durham CT, 9 AM-3 PM. Setup Sat., Oct. 7th, at 4 PM. VE Exams; contact *Joel Curneal N1JEO, (203) 235-6932. Sponsors: Meriden ARC; Middlesex ARS; and Shoreline ARC. For Hamfest info, call* Bill Wawrzeniak W1KKF, (203) 269-8252 eves. *General info on packet* KA1NRG.CT.USA.NA. *Vendors contact* Dan Murphy KA1SZP, 162 Tri-Mountain Rd., Durham CT 06422; (203) 349-1304 eves.

SPECIAL EVENT STATIONS

SEP 9-10

ASHEVILLE, NC The Western Carolina ARS, and its club station W4MOE, will hold its annual Special Events Operation from Mt. Pisgah and Blue Ridge Parkway, 1600Z Sat.-1600Z Sun. The event commemorates the 100th Anniversary of the opening of the Biltmore Estate by George Vanderbuilt, which included the Mt. Pisgah and Pisgah Nat'l. Forest area. Operations will be on HF, VHF and UHF, with modes including SSB, CW and Packet. For QSL and a special commemorative certificate, send your QSL card and a large manila SASE with two units of postage, to *W4MOE, c/o WCARS, P.O. Box 1488, Asheville NC 28801*. For info, contact *Dan Henderson WA4QQN, Operating Event Coordinator, WCARS, P.O. Box 188, Skyland NC 28776. Tel. (704) 669-4450.*

SEP 11-16

ATLANTIC CITY, NJ Southern Counties ARA will operate K2BR from the Miss America Pageant on Absecon Island (IOTA· NA 111). Freq.: Phone - 25 kHz inside lower General class bandedge; CW - 65 kHz inside lower General class bandedge; Novice 28.100 - 28.500 kHz. QSL with #10 SASE via *SCARA, P.O. Box 121, Linwood NJ 08221*. A certificate commemorating the 25th Anniversary of the Station and the 75th Anniversary of the Miss America Pageant will be sent with the Miss America QSL card. Operations will start at 10 AM EST, Sep. 11th.

SEP 17

NEWTOWN, CT The Candlewood ARA will operate W1QI 1300 UTC-1700 UTC to commemorate its 55th year of affiliation with the ARRL. Operations will be on or near 7.280 and 14.280. For a certificate, send QSL and a 9" x 12" SASE to *CARA, P.O. Box 3441, Danbury CT 06813-3441.*

SEP 23

GILFORD, NH The Nashua Area RC will conduct a demonstration of amateur radio at "New Hampshire Jamboree '95" at the Gunstock ski area. Station WB1FFZ will be on the air from 1200 UTC-2100 UTC. Freq.: Phone - 3.940, 7.090, 14.290, 18.140, 21.360, 28.350, 24.960, 28.350, and 28.990; CW - 3.590, 7.030, 14.070, 18.080, 21.140, 24.910, 28.190; Packet - 145.09. QSL, with an SASE, via *WB1FFZ.*

SEP 23-24

RALEIGH, NC WB4ZTF will operate 1300Z-2400Z, both days, to commemorate the Sons of Confederate Veterans presentation of "Echoes of Dixie," the reenactment of the War Between the States (Battle of Wyse Fork NC). Operation will be on 10 and 20 meters CW around 28.350 and 14.050 MHz. Listen for CQ CSA. For a certificate, send QSL and a 9" x 12" SASE to *Stanley M. Grady WB4ZTF, 2512 Win Rd., Garner NC 27529.*

VIRGINIA BEACH, VA The Virginia DX Century Club will operate KE4ZYX from 1400Z-1800Z both days, to commemorate the 20th Anniversary of the Virginia Beach Hamfest. Operation will take place at the hamfest site, on phone and CW, in the General class subbands of at least 20 and 40 meters. For a certificate, send QSL and a 9" x 12" SASE to *N4AIG, 528 Water Oak Rd., Virginia Beach VA 23452.*

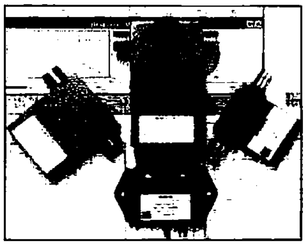
OCT 7

PISCATAWAY, NJ The Piscataway ARC will operate AA2KS 1300Z-2100Z to commemorate Marconi's first wireless transmission from the Twin Lights at the Navesink Highlands in NJ. Operation will be in the lower portion of the General 80, 40, and 20 meter phone bands. For a certificate, send QSL and a SASE to *PARC, P.O. Box 1233, Piscataway NJ 08854.*

NEW PRODUCTS

Compiled by Victor Lapuszynski

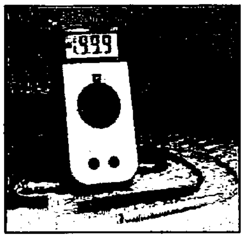
Par Electronics



Par Electronics has introduced filters to help resolve the increasing problem of intermod interference and desense on 2 meters. Previously, expensive and bulky bandpass filters were used, or else smaller ones that needed to be switched out during transmit because of insertion loss. The VHFDN152 solves the problem by notching out the offenders—paging services located in the 152–153 MHz range. Insertion loss is close to zero, VSWR is less than 1.2:1, and the filter allows for reception of the 120–175 MHz spectrum for those radios so equipped. A smaller model (VHFDN152HT) at lower power has male and female BNC connectors to connect directly to an HT. The VHFDN152Q, which measures 2" x 4" x 3.5", is designed for packet and mode B satellite users. This filter permits notching an offending frequency as close as 700 kHz to the desired passband.

Each of the amateur models has a counterpart for VHF scanner enthusiasts. For more information, contact: *Par Electronics, 6869 Bayshore Dr., Lantana, FL 33462; (407) 586-8278, fax: (407) 582-1234*. Or circle Reader Service No. 201.

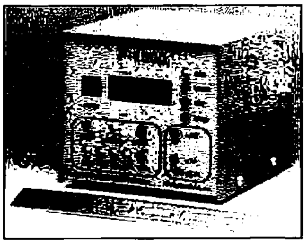
Fieldpiece



The LT6 is a low-cost DMM that works with all of Fieldpiece's accessories. Service technicians want a multimeter that's inexpensive and has ranges and functions that they can use, without a lot of unneeded functions that just get in the way. For $39.00, this unique meter measures volts (AC/DC), ohms, and amps (AC/DC), indicates continuity by beep, and tests power semiconductors for catastrophic failure. Yet it can further attach accessories such as a 300 A current clamp, a dual-temperature converter, a microamp head, or a relative humidity head. Furthermore, for low ranges (200 mVAC/mVDC), the LT6 can display an accuracy 10 times that of most other DMMs.

Fieldpiece offers products that are small, easy to use, and versatile. For further information, contact: *Fieldpiece Instruments, Inc., 231 E. Imperial Highway, Suite 250, Fullerton, CA 92635; (714) 992-1239, fax: (714) 992-6541*. Or circle Reader Service No. 202.

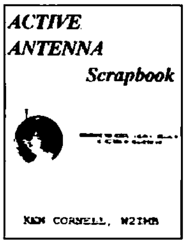
RF Applications



The P-1500 Digital RF Power/VSWR Indicator is the newest addition to the company's family of digital RF power measurement equipment. The P-1500 features a four-digit numeric and a bargraph-style display. Forward power, VSWR, reflected power, and true power can be displayed. Using a built-in sensor, the P-1500 automatically selects from three ranges (0–120 W, 0–750 W, and 0–1,500 W), so there are no range switches. Frequency coverage is 1.8 to 30 MHz. The P-1500 continuously monitors VSWR, and there are indicators to signal VSWR over 3.0 and less than 1.5 (even when VSWR is not selected on the display). The P-1500 operates on 12 VDC and measures 4" wide by 3.5" high by 4" deep. The P-1500 lists for $219.95. *RF Applications, Inc., 9310 Little Mountain Road, Kirtland Hills, OH 44060*. Or circle Reader Service No. 205.

Active Antenna Scrapbook

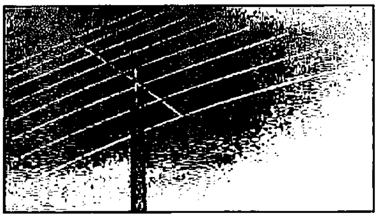
So what's an "active antenna?" It's one using a preamplifier, generally to make up for a shorter antenna than would work best. But it also helps cut down your noise. Read all about it in a 29-page, self-published booklet by Ken Cornell W2IMB. It has antennas, and circuits for a bunch of easily made preamplifiers. Ken may even get you interested in checking out the very low frequencies using some of his active antennas and regenerative detectors. The book is $10 postpaid from *Ken Cornell, 225 Baltimore Ave., Point Pleasant Beach NJ 08742 (908-899-1664)*. Tell him Wayne sent you.



On the other hand, maybe you aren't curious about stuff like this, in which case find a 5- by 10-cm board about a meter long and start hitting yourself on the head until you wake up. Or circle Reader Service No. 204.

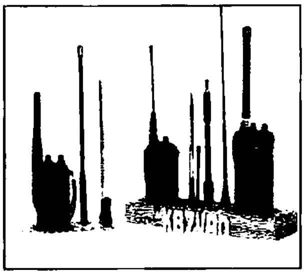
Cushcraft Corporation

Cushcraft has announced the ASL-2010 SkyLog Log Periodic Antenna for hams who would like to have a single antenna covering 13.5 through 32 MHz. Because it uses a single feedline, with included balun, there's no need to switch antennas when changing bands. The antenna is not power limited and can operate easily and continuously at full legal limit. Without any kind of traps, the wind load is reduced significantly (10.1 sq. ft.). Boom is 18'; gain, 6.4 dB; and it has eight elements, the longest of which is 38'. Boom, elements, brackets, and mounting plates are aluminum; U-bolts and worm clamps are stainless steel.



List price is $800. For more information, contact: *Cushcraft Corporation, P.O. Box 4680, Manchester, NH 03108; (603) 627-7877, fax: (603) 627-1764, E-mail: sales@cushcraft.com*. Or circle Reader Service No. 203.

Shack Attack



Here's a great way to keep your HTs from getting knocked around. The Handie Station, from Shack Attack, provides a safe way to store your HTs and keeps the antennas handy. The Handie Station is made from alder wood (a medium-dark wood) and has a drop-in slot that is custom cut to your HT specs, with additional drop-ins to hold antennas. The top edges of the Station and drop-ins are routed, so your HT is easy to put in and take out. The bottom of the HT drop-in slot is lined with rubber to cushion your radio, and rubber grips are fastened on the base to prevent slipping. Each Handie Station is personalized with your callsign mounted on the front in large 2" laser-cut letters made from 1/8"-thick birch. Each unit is sealed with two coats of clear polyurethane gloss for a beautiful natural appearance.

There are two models to choose from, each having a small footprint that is easily accommodated by any ham's shack. The dimensions of the one-radio model, "Single Handie Station," are 6" x 3-1/2" x 2", and it holds four antennas. Those of the two-radio model, "Dual Handie Station," are 11-1/2" x 3-1/2" x 2", and it stores up to six antennas.

The Single Handie Station is available from Shack Attack for $12.95; the Dual Handie Station is $15.95. Shipping and handling is $3.50 for each item ordered. Be sure to include the dimensions or footprint and make/model of your HT. Quantity discounts and club fund-raiser programs are available. Call toll-free (800) 573-7388. E-mail: kb7vrd@aol.com. *Shack Attack, 1394 N 770 W, Dept. 73, Orem, UT 84057-5903*. Or circle Reader Service No. 206.

PROPAGATION

Number 24 on your Feedback card

Dennis S. Kopecky WJ2R

Dennis S. Kopecky WJ2R
P.O. Box 875
Rahway, NJ 07065

Amateur Persistence

The first rule of DXing (and all of amateur radio, too) is: Listen, listen, listen.

The next most important rule is: Be there to practice Rule No. 1!

Okay, so we all admit conditions could be better. But along with filling in for your column's conductor once in a while as he takes a much needed vacation, it also gives me great pleasure to do Rule No. 1 as often as time permits. And as many of you as possible should be out there to do Rule 1, as often as your time permits.

Consider the major contest weekends: Even if conditions are not like what we saw in 1989 through 1991 or 1992, we still see phenomenal scores. But why? Because the bands are heavily populated with a large part of the amateur community out there, participating for whatever reason they wish, the chances of making that needed contact are bettered. My point is that even when conditions are not supposed to be good, it may still be possible to work the DX that you might have missed if you hadn't tried. If enough stations worldwide would take this "let's-try-and-see" attitude, conditions might not really be so bad after all. I know that even with these "poor" and "fair" levels in W1XU's forecasts, in the weeks preceding this column I was adding a country or two a week, beyond DXCC!

September promises to be a month of contrasts in the propagation scene. We can expect some fireworks in the early and middle parts of the month, but too much atmospheric noise will make DXing a hobby for the patient and persevering. It may be possible to work some DX in the higher bands during the last third of the month. As always, look for conditions to match what is predicted, one or two days before or after the specified date, and also don't forget your 18-minutes-after schedule with WWV, to get an indication of the current conditions.

10 and 12 Meters

Not expected to be very good, but still should be monitored for trans-equatorial/tropical paths during the daylight hours.

15 and 17 Meters

Similar in overall outlook as 10 and 12 meters, but with better chances to work DX because of the outright popularity of these bands throughout our worldwide community.

20 Meters

This is your workhorse band for worldwide DX during the daylight hours this month, with occasional openings beyond local time sunset, moving from east to west, and long skip north and south.

40 Meters

DX on this band should be available from just before sunset until just after sunrise, which also means broadcast station interference in the phone portion of the band. Concentrate on the days marked fair or even poor, as conditions on the higher bands (which should still be checked) may make them unusable.

80 and 160 Meters

Expect some fairly good DX and short-skip openings during the hours of darkness, which, as we enter the change of seasons, will be lengthening the time we will be able to pursue our pastime!

VLF (160–190 kcs)

Anyone with interesting happenings in this portion of the spectrum are invited to contact either Jim or me. We'd like to receive data regarding conditions over a period of time—that is, fair, improving, to very good over a period of days, and vice versa—with signal levels, distances worked, time of day, and so forth (the usual stuff! TNX). 73

SEPTEMBER 1995						
SUN	MON	TUE	WED	THU	FRI	SAT
					1 F	2 P
3 P	4 F	5 G	6 G	7 F	8 F	9 G-F
10 F	11 F-G	12 F	13 F	14 P	15 P	16 P
17 F	18 G	19 G	20 G	21 VG	22 G	23 VG
24 G	25 F	26 G	27 G	28 F	29 F-G	30 G

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

1Check next higher band
*Bp-Meters possible on good days only

September should bring some very disturbed conditions blended with excellent fall propagation on the HF bands. Expect an unsettled geomagnetic field on the 1st and 2nd, and an active field from the 5th or 6th through the 10th. We may see the return of significant sunspot activity—and possibly a flare! Earthquakes and volcanic eruptions possible around the 2nd and 11th.

G = Good, F = Fair, P = Poor, * = Disturbed magnetic field coupled with some unusual geophysical conditions (50–75% probability).

73 Amateur Radio Today

OCTOBER 1995
ISSUE #421
USA $3.95
CANADA $4.95
A WGI Publication
International Edition

QRP DELIGHTS!

Mini-Tuners
Solar Generators
VFOs

73 REVIEWS

Ramsey XS-20 QRP 20m Transceiver

Maggiore Hi Pro R1 Repeater

NEW COLUMN!

Your Input Ideas in "Ham to Ham"

73® Amateur Radio Today

October 1995
Issue #421

TABLE OF CONTENTS

FEATURES

REVIEWS

Mike Spasoff KE6QNM and Dan Radovich KE6SOO on the Mars Rover. Read all about it in "Hams With Class" on page 66.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover: "What is he, an agent for the UFOs?" Actually, he's Dave Hess KD6LZA, and you can find out what he does with this outfit in "Homing In" on page 62.

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North. Peterborough NH 03458. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm. Ann Arbor MI 48106 POSTMASTER: Send address changes to *73 Amateur Radio Today*. P.O. Box 7693, Riverton NJ 08077-7693.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Money Ideas

There are good solid money-making ideas going by you every day. That's not important if you have all the money you need, and your wife does, too (which is highly unlikely). I think the complaint I hear the most from readers has to do with money. Hey, it's out there: all you have to do is keep your eyes, ears, and mind open for opportunities.

For instance, I was reading an article in Forbes about the popularity of low-powered FM transmitters. The article mentioned an FM transmitter kit available from Pan-Com International by mail order for $130. It also mentioned a 20-watt amplifier kit from Ramsey for $100. So I checked the Ramsey ad in *73* and found that they also have a nice little FM transmitter kit for $35. For another $15 you can get a case for it and an antenna. Hey, for $50 you're on the air with a few milliwatts. Not legally, of course. And it's even worse if you invest the extra hundred in an amplifier and start broadcasting your own call-in talk show to your neighborhood. Watch out, Rush!

The chances of being caught seem remote, unless you irritate your listening audience enough so they complain to the Candy Company. The FCC's response, when irritated enough to track down FM band pirates, is usually to confiscate the station. Of course, if you have a ham ticket, they will probably lift that, too, so I'm not even remotely suggesting that you set up an FM station, start broadcasting, and sell advertising. But, as a ham, and presumably with some radio smarts, you might be able to help people who want to be able to play music around their home or business without having to install a bunch of wires. I know I'd like to be able to listen to my CDs when I'm out digging up dandelions or picking raspberries. My lawn produced over 500 pounds of dandelions this spring.

The public, with few exceptions, are panicked by anything electrical. Our schools have, for the most part, stopped bothering to teach science, so most people haven't a clue as to how electricity or radio equipment works. Thus, when faced with a desire to use something radioish, they turn in frustration to anyone they can find for help.

If you were to advertise that you can install a miniature FM transmitter for people to play music around their home or office for $249.95, you might be able to make some money. I know I could. Anyone who has a hi-fi system would be a good target for a sale. Imagine being able to load your CD player with a stack of CDs and listen to the music you want while you do yard work.

The circuit for the blood purifier I've been writing about is dirt simple for any ham to construct. It's little more than a small radio battery with a relay to reverse the polarity and apply a low voltage to the ankles in order to pass about 50 microamperes of current through the blood going through the leg arteries. This is reported by the Albert Einstein School of Medicine as a way to wipe out HIV, herpes, and a few other miseries caused by bugs in the blood. I've had calls from people with AIDS who are desperate to make a unit, but who are completely unable to deal with the simple circuit. They've visited their neighborhood Radio Shack, and found no help there. So I tell 'em to find a local ham. Knowing the power of the FDA, et al., which seem dedicated to keeping AIDS an incurable disease, I'm afraid to get involved any more closely.

If you have been living in a cave and aren't aware of what the FDA, the medical establishment, and the drug and insurance companies are up to, then it's time for you to come out of the cave and start reading a little. There's no shortage of books and newsletters to educate you. I'll have to review the Christopher Bird book on Gaston Naesens for you, for starters. Then you'll want to read about Royal Rife, Wilhelm Reich, and a few others who've been their victims. It's almost enough to make a person think.

Lots of New Ideas

For instance, at the Monaco cold fusion conference I met Jerome Drexler, who's making LaserCards. This credit-card-sized card can optically store up to six megabytes of data. That's around 2,400 typewritten pages of information. Now, how many applications can you think of for this beaut?

Hospitals are using it for health records their patients can carry with them. Imagine being able to carry around your complete life medical history! The Army is using them to eliminate tons of paperwork when handling or shipping supplies. Shipping lines are using them to keep track of cargoes in detail, thus eliminating paperwork and the filling out of forms. The shipments are marked by bar-codes and the record sent along on the LaserCard. No more typing. Plus it speeds up dealing with customs in other countries.

Other applications might be a color photo where identification is important. Maybe a voiceprint or a fingerprint? This could help eliminate credit-card fraud, which is costing us credit-card users billions a year.

The company also makes a smart card with a built-in microprocessor, which has room for 1.5 megabytes of data. The cards can be used to store data, pictures, software, PINS, your signature, and so forth

So where do you come in? Hey, someone has to go out there and start selling the product. How many potential users are there within easy driving distance of you? The odds are that most companies haven't heard of the product, nor even thought about the potential benefits it could provide.

Let's suppose that a major retailer wants to keep track of what their customers are buying and how often. A card like this could let me as a customer buy anything I want and the store would automatically charge my Master Card account without any need for further identification. It would keep track of my purchases and issue me credit when they reached certain targets—like frequent flier miles.

Sony/Philips gets a nickel royalty on every CD made. With around a billion CDs being made a year, that kinda mounts up, doesn't it? If, as a sales agent for the card, you could get 5¢ each, it wouldn't be long before you could afford to renew your *73* subscription. And buy a Porsche.

But there are endless new products and services which need to be sold or manufactured. Your success in life is limited only by your imagination and ability actually to follow through with a project.

Computer Service

It doesn't take a world of smarts to fix computers, but if you get into the business you'll find that hundreds of local small businesses are going to be interested. Small companies can't afford to hire a computer guru to set up their system and keep it running. And, as a ham, presumably you are not afraid to take the lid off the box and see what's gone wrong inside. It's probably the disk drive. Or a loose connection in the monitor.

Operating out of your basement, spare room, or garage will give you the low overhead you need to compete with the big boys and build your customer list. Then, visit them every week or so and see how things are doing. Find out if they are happy. Tell them about new hardware or software that might benefit their business. Maybe you can get them onto the Internet and sell them a 28kbps modem to speed things up.

I don't want to hear how you don't have the money for a subscription. I want to hear from you when I suggest we make a ham and scuba diving trip to Truk, and you tell me you have the money and are raring to go. If you're making plenty of money, what do you care if the new Kenwood or Icom rig is $1,000 or $5,000? And if you aren't making money, why the heck not? It's out there in big gobs. But you do have to work for it. Well, actually, it's more like funning for it, if you enjoy what you're doing. If you're not having fun making money, it's time to reorient your life, even if you have to start over and build new skills.

Missed Opportunity?

A letter from Harley W9ALU included a newspaper article about a

Continued on page 74

LETTERS

Number 2 on your Feedback card

From the Ham Shack

Bob Davis N3OYA Well, Uncle Wayne, you've been pestering me to write, so here goes. Thanks for bugging the heck out of complacent hams like me and getting us out there doing something. As per your instructions, I have started my own business (in my spare time, at least, until it takes off and I can quit the broadcasting business), making and selling custom-made drums. I also am involved with teaching young drummers and percussionists the ethereal art of drumming.

There's more: My business, called RPD Consulting, also advises various organizations in the field of sound reinforcement, such as churches, parks, etc. This stuff keeps me busy, as you can imagine, and it doesn't pay very well (yet), but I find the time for more musical undertakings, such as local community bands and my own band, Royal Disaster, which plays all manner of music, from The Beatles to the Allman Bros. I even get a little time in for hamming with my local club and casual operation hunting special-event stations. Boy, do I love those colorful bits of paper!

I enjoy your editorials; don't ever stop raising a ruckus. I have even dared (gasp!) to research the basics of cold fusion, and have been deluged with so-called educated people who insist that the concept is rubbish. Oh, did I mention that the majority of the non-believers have never bothered to find out the tiniest modicum of background? For instance, a very good friend of mine, who happens to be as far away from science as one can be (he has degrees in history and classics), insists that the idea of cold fusion is bunk. I even let him read a few of your editorials on the subject, but he remains unswayed. He did, however, enjoy the rest of the content.

Hey, Unk, let me tell ya a story. When I first began reading *73* and saw your editorials decrying smoking, drinking, and all those other supposedly nasty things, I said to myself, "Stuffy old codger—he don't know what he's missing." Well, let me tell you this: I was the one missing out. With the help of my girlfriend and Uncle Wayne, I've been smoke-free for 5 months now, and plan to remain so. As you're probably aware—and you can let your readers know this—quitting the habit is not a cold-turkey undertaking! It's something one lives with day by day. Even today, not waking up with a craving for Philip Morris is a small victory, and you should see me when I walk past that ever-present rack on the way to the gas station's counter! As that wise man, Mel Brooks, says: "Oy!" If you ever need a session drummer for your recording studio, let me know. *Six years after the Wright Brothers flew, Edison was still insisting that man would never fly . . . Wayne.*

Scott Robbins KY2PI I read with interest your pontificating on the state of the ham radio business in the July issue of *73*. As an employee of a major retailer of ham radio equipment for the last year, I'd like to share a few observations.

First, you're right about the no-code licensees not buying all-band HF rigs and not upgrading their licenses. There are a couple of good reasons for this. The average person who gets a no-code license has just wanted to get a step up from CB radio. They've tired of the yelling and all the other nonsense you hear all day on 27 MHz, and see 2 meters as their salvation from this mess. There are also a significant minority of no-coders who are getting involved in the hobby because they see the autopatch systems as a substitute for cellular telephones and are not in the slightest interested in anything else to do with ham radio.

Secondly, as a ham of 13 years, I am absolutely appalled at the lack of technical knowledge the new ham community has. Very, very basic stuff, like how much current your new mobile rig will draw or why an 11" tall antenna has no gain is beyond the grasp of many new licensees and, what's more, they really don't care! All that technical "crap" is in the way of doing what they want, which is to get their mobile rig set up (with an unobtrusive antenna, of course) and hit the repeaters. The ripple effect of this has been that many of these people *do* upgrade in order to get on HF SSB and then are absolutely clueless about basics like proper grounding, antenna construction, even how to solder on a PL-259! The 90s are the age of the solderless ham, believe me.

The next comment I'd like to make is about the profit margin involved in selling ham radio gear. Twenty-five percent?! You can't be serious if you think we're making 25% profit selling ham gear; 5% to 10% is the standard these days, and often it's even lower. Why? The yen/dollar issue is certainly part of it, because prices are so high that it's putting good gear out of reach, but really it's because the competition is incredible. We keep track of our competition's pricing, we know what the rigs cost, and we're all taking a bath for the most part. I'm not cooing for sympathy with that statement—it's fact. You know as well as I do that even having a five dollar better price on the competition on a $2,000 HF rig can mean you get the sale, and that sale will be made by whoever has the lowest price, period. Saw a great price on a rig in the ads today? Probably a slow moving item that a dealer is dumping at or near cost to get his capital invested somewhere else. In the meantime, we're not able to match that price and can't move inventory. Amateur radio sales is a highly competitive business and I challenge your assertion that there are "so few" ham dealers now. There are too many, selling gear at such a low profit margin that it makes it really tough to keep our heads above water. Also, (to the public) don't you think for a minute that the salesman answering the phone is making a killing off of you. For the amount of information you need to have in your head to be able to competently sell items from many, many companies, not to mention the technical aspect, we don't take home as much as that from a comparable job, at least in my city.

In my opinion, the only thing driving sales in the ham business right now is the no-code Tech license. Without it a lot of us would be looking for work right now rather than dogging the 800 lives. The only way the ham business is going to survive in the cut-throat 90s is for these new hams to be instilled with technical knowledge, upgraded licenses, and cheaper gear. The prognosis: We'll see.

Terry Weinhold N3EUL Permit me to voice my opinions on "Never Say Die," July 95 issue, concerning codeless Techs, and an "artificial and new irrelevant code barrier. . . ." I am currently a General class operator, licensed over 11 years, with my main interests being HF, CW, and phone as well as 2m FM. I am a very active amateur, and my age is 40. Trying to look at codeless licenses objectively, I believe it was a mistake to form this license class because, after being active for years, I have seen a degeneration in, shall I say, the intellect of 2m operators. Without prior knowledge of their license class, I can reliably pick out who has the no-code Tech license due to their on-the-air speech and manners. I'm sure you have heard this before, but 2m sounds just like the CB band does, and when we had a code requirement, I noted a higher-quality operator. 'The ham population is declining, so we had to form a codeless license to attract more people." Really? Sir, I will say, and perhaps I speak for the majority, if the code requirement for HF is eliminated in this country, I fear the bands will be one gigantic CB band. At this time, all the good operators will say its time to sell the gear and get out. Then they *will* have a declining amateur population!

I would be pleased to see the amateur population grow, especially among young people, but *please*, lets not sacrifice quality for quantity.

By the way, I did enjoy your portion on weight control, and my congratulations to your wife and yourself. I have recently lost 10 pounds, and your article was an inspiration to me.

Pete Thellier KI4KN I always enjoy reading your editorials and, based on your recommendations, have been reading about the influences of electric and magnetic fields on life processes.

Years ago a friend of mine in Europe used a device that passed a minute electric current (in the order of 50 to 200μA) through the body. This was simply a battery, meter, pot, and electrodes. In fact, I think it was a commercially available device. This friend suffered from fainting spells and other disorders. He swore that this device helped him by stimulating his blood circulation and that it could also speed up healing. I had not taken any of this too seriously until I began reading *Cross Currents* by Robert O. Becker, M.D. and decided that there may be something to it. From what I have read the current is probably still way too much at 50 μA.

Thanks for your help and keep giving us hell in your editorials: most of us are just too complacent.

QRX . . .

Number 3 on your Feedback card

The Ham Arundel News

We have just experienced two of the highlights of the year. I'd rate our annual picnic an overwhelming success. John N3MNM, and Sylvia Poulhaus did an outstanding job planning and coordinating the event. The weather man cooperated, and the day turned out to be exquisite in all respects. The coordinators had much help with setting up, cooking, and cleaning. The food was great and the company was exceptional. We even had entertainment: a magic show and a clown. Thanks to all who made this the best picnic yet.

This past weekend the weather was not quite as cooperative for our annual Field Day. Lois Turner KA3VVQ and Bob Baltz N3MNT coordinated a very successful event. Lois worked out preliminary details and prepared a great dinner for those present on Saturday. I have always been amazed by the enthusiasm exhibited by Lois. She is definitely Ms. Field Day. Bob, in his usual efficient manner, supervised the setup, operation, and takedown of the event. Bob is surely one of AARC's greatest assets. He never hesitates to help or participate in our club activities.

Thanks again to all those who worked to make this a very successful Field Day weekend. It will be interesting to see our score for the event. Our intent was to enjoy the weekend with our friends, to learn more about radio, and, finally, to make contacts and score points. I think that all of our stations fared quite well. We are indeed fortunate to have members who give up so much of their time to produce events that benefit all of the members. TNX *to Dick McKelvie KE3HQ, and* Ham Arundel News

Recording Pioneer Dies

Marvin Camras, a pioneer of modern magnetic sound recording, died Friday, June 23, at Evanston Hospital. He was 79.

Mr. Camras, who lived in Glencoe for 40 years, was a senior scientific advisor and a professor of electrical engineering at the Illinois Institute of Technology.

Mr. Camras helped develop multitrack tape recording, magnetic sound for motion pictures, and stereophonic sound reproduction. He is credited with discovering high frequency bias. His patents, numbering more than 500, have been licensed to more than 100 manufacturers, including IBM, Sony, and Kodak, and include several for magnetic and electronic storage on videotape and floppy disks.

He was referred to as "the father of modem magnetic recording." In addition to being inducted into the National Inventors Hall of Fame in 1985, Mr. Camras was awarded in 1990 a National Medal of Technology, the nation's highest award for technological achievement by President George Bush,

He was named "Inventor of the Year" in 1979 by the Chicago Patent Law Association. As a hobby, he crafted violins and violas.

Mr. Camras never officially retired from IIT, where he was a popular instructor, but took a leave of absence two years ago due to failing health.

Bom in Chicago, he received his bachelor's degree in 1940 from Armour Institute of Technology, now IIT. He received his master's degree in 1942 from IIT. In 1978 IIT awarded him an honorary doctorate.

"He was one of the really major figures in the development of electronics in the U.S.," said Lew Collens, president of the Illinois Institute of Technology, where Mr. Camras worked and taught for more than 50 years.

"He moved us from wire recording to magnetic recording. All of the video electronics we have today, as well as the audio, all that traces back to what Marvin did."

Mr. Camras began building electrical devices when he was a child. At age 4, he built a flashlight, and at age 7, a transmitter.

At age 22, in 1938, Mr. Camras developed magnetic tape, so his cousin, an aspiring opera singer, could record his singing in the shower. Magnetic recording was more precise than wire recording and paved the way for audio and video tape.

Mike Wolfe N9CHQ said, "Marvin Camras W9CSX attended a number of NSRC meetings after giving a talk about his association with magnetic recording at a meeting in the early 1990s."

"I was Vice President at the time, and Art Appel, who knew Marvin, told me that he would make a good speaker for a club meeting. Art helped arrange for the talk. It was a very highly attended meeting, as it is rare to get such a highly respected inventor to speak at a club meeting. He demonstrated a wire recorder and played us a recording that was made many decades ago."

Art Appel adds that Marv was licensed since the 1920s. Art knew him 53 years and had worked with him 7 years. Marv received the Franklin Medal and an award from the Society of Motion Picture Engineers. He wrote *Handbook of Magnetic Recording*, which is still read today. He designed and built his own house in Glencoe. TNX *to the* NSRC Transmitter

Three Hams Die in LA Shooting

Three Los Angeles-area amateurs are dead following a shooting rampage at a city facility.

A disgruntled radio repairman for the City of Los Angeles on July 19 is charged with killing four men, all supervisors at the city's Piper Tech Center. The three amateurs killed were Marty Wakefield N6BZ, 57, of Venice; Neil Carpenter KA6QIB, 61, of Palmdale; and Anthony Gain W6KFN, 78, of Montebello. A fourth supervisor who was killed in the attack, James Walton, was not a ham.

Gain, an Advanced class licensee, was trustee for a repeater operated by the city. He had chosen to continue to work rather than retire, said a coworker, Rob Hanson AA6BN. Wakefield was an active DXer and until May had been an ARRL volunteer examiner. Carpenter held an Advanced class license. All four shooting victims also held FCC General Radiotelephone licenses.

All three amateur-licensed victims were active in the Los Angeles City Amateur Radio Volunteers, a club aimed at helping city employees become licensed, with an eye toward emergency preparedness functions, Hanson said.

The alleged killer has been charged with four counts of murder. TNX *ARRL*

Repeater Map Book

The new ARRL North American Repeater Atlas is out. The publication is not to be confused with the pocket-sized repeater directory. The Atlas features repeater maps for every US state and Canadian province, plus Mexico, Central America, and the Caribbean. Contact League headquarters for pricing and availability.

Also, the ARRL will produce a handout aimed at new hams, explaining the concept of band planning. The publication will include a listing of ARRL approved plans. TNX *Newsline*

ARRL Honors Hams

The ARRL Board of Directors has honored several hams for their contributions to Amateur Radio. Dick Jansson WD4FAB has been named recipient of the ARRL Technical Merit Award for his work on amateur satellites. Philip A. Downes N1IFP is the ARRL Professional Educator of the Year for 1994, with Charles Ward KJ4RV tabbed as the ARRL Professional Instructor of the Year for 1994. Chris Townsend NU7V won honors as the Herb S. Brier Instructor of the Year. Karl Lambert KB4DCR won the Excellence in Recruiting Award and the Board selected Dr. Ulrich L Rohde KA2IWEU to receive the Technical Excellence Award for his series of articles on Key Components of Modern Receiver Design, which appeared in the May, June, July, and December 1994 issues of *QST*. Joseph Phillips K8QOE and Michael Karp AF2L are the co-recipients of the Philip J. McGan Silver Antenna Award for 1994. TNX *Newsline*

A Winner

Long Island, New York, Packet sysop Rick Lapp KC2FD, who turned 46 on July 18, has won his third pentathlon title at the Masters U.S.A. Track and Field Championship in East Lansing, Michigan. The event is for amateur athletes 30 years or older. The pentathlon consists of the long jump, discus, javelin, and 200- and 1500-meter runs. His wife Linda is also a ham with the callsign N2MUP. Rick is an honorary member of the Suffolk Police Amateur Radio Club. Despite putting in long hours as a packet BBS sysop, he somehow finds time to compete in regional, national, and international U.S.A. and AAU-sanctioned track and field events. TNX *Newsline*

Number 4 on your Feedback card

The QRP Delight

A full-featured antenna tuner with built-in SWR meter.

by Phil Salas AD5X

How would you like a full-featured antenna tuner with a built-in SWR meter for your QRP station? And I'm talking about an instrument that fits in the palm of your hand (see Photo A), operates even on 160 meters, works up to a power level of about 10 watts, and has a total cost of less than $25! Well, I needed something like this to complete my compact QRP station. The QRP Delight was the result of my efforts. The QRP Delight combines a very effective SWR meter with a wide-range antenna tuner, which is perfect for matching random wires thrown out of hotel windows. Interested? Read on!

The SWR Meter

The SWR meter is a variation of a resistive bridge popularized by the late George Grammer W1DF (circuit shown in *QRP Notebook* by W1FB). This circuit has the advantage of providing high sensitivity at low power inputs. Its disadvantage is that the maximum power that can be applied to the circuit is limited by the power dissipation of the 50-ohm bridge resistors because 75% of the transmit power is absorbed by these resistors under perfectly matched conditions. In the original W1DF circuit, the two 1k resistors shown in Figure 1 are replaced by two 50-ohm resistors; no 100-ohm resistor is used, and you must use a 2P-3T switch for OPERATE, CALIBRATE, and SWR. In the OPERATE position the entire SWR circuit is bypassed, so there is no metering of relative power. In this circuit I use a DPDT switch to add in a 100-ohm resistor only for SWR readings, allowing the circuit to provide a reasonable SWR for your transmitter even during severe tune-up conditions. Additionally, you have minimum insertion loss in the FORWARD position because the 1k bridge resistors permit you to always indicate forward relative power and calibrate the full-scale reading for SWR measurements.

The Tuner

The antenna tuner itself is a standard T-type tuner utilizing a pair of 335 pF miniature transistor radio variable capacitors and a toroidal inductor, tapped as shown in Figure 1. To actually make the taps, I simply wound the toroid with 40 turns of #24 wire, and then scraped the outer surface of the appropriate turn with a hobby knife to clean off the enamel insulation. I then tinned each wire turn, and tacked soldered tap wires to them.

Construction

The actual layout of the parts in the QRP Delight is a function of the sizes of the components you wind up with. Try to find the smallest parts you can—especially for the DPDT switch, the potentiometer, and the meter. From Photo B you can get a pretty good idea of how mine is laid out. I used Radio Shack variable capacitors which had no means of mounting them to the front panel. To mount them, I used a dab of hot glue to hold the capacitors in place while I applied epoxy and waited for it to cure. If you use the Mouser variables, you can purchase mounting screws for them (see the Parts List). I also used hot glue to hold the meter in place. To mount the inductor on the rotary switch, first bend the switch solder tabs out away from the center of the switch. Then you can position the inductor tap wires so that they easily drop into the solder tabs. Finally, use some miniature microphone cable to connect the BNC connectors to the

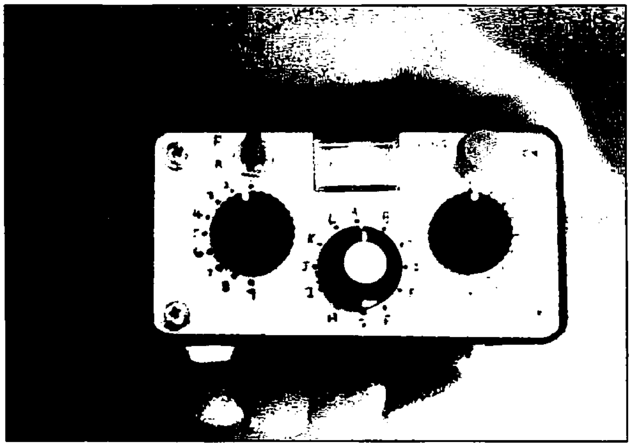


Photo A. The QRP Delight.

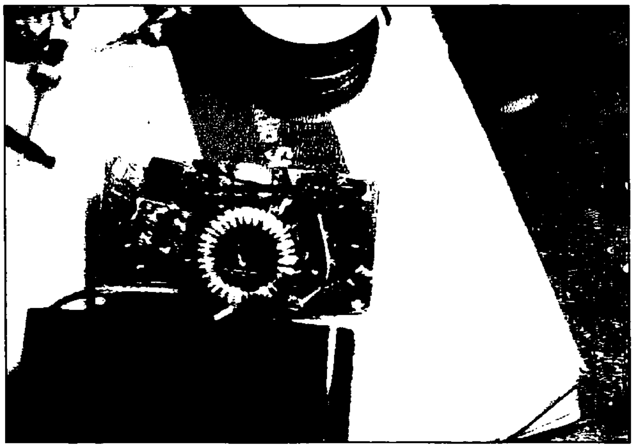


Photo B. The "innards" of the QRP Delight.


Photo C. The random wire adapter.

Photo D. The back of the QRP Delight, with the random wire adapter.

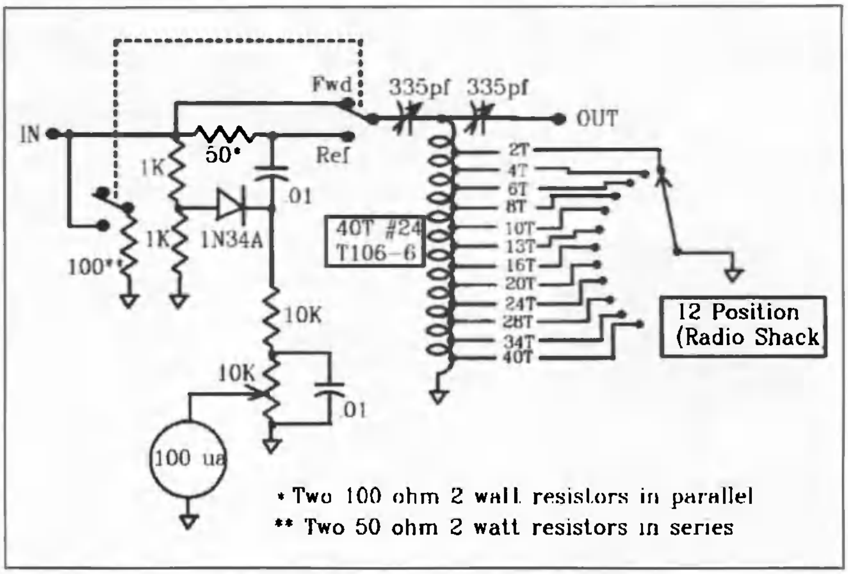


Figure 1. QRP SWR meter and antenna tuner.

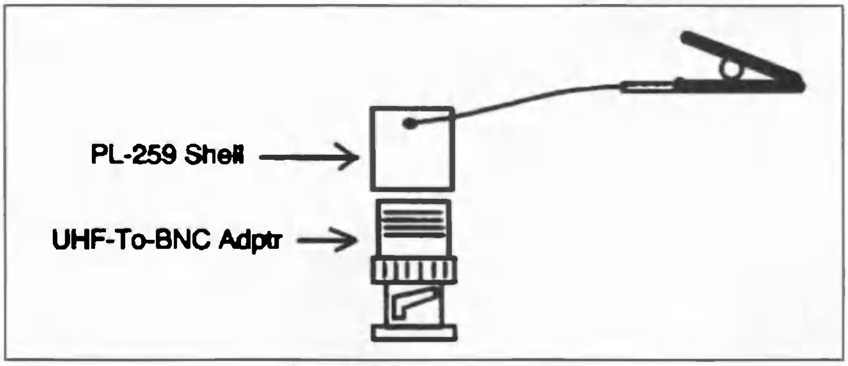


Figure 2. Random wire adapter.

QRP/tuner circuitry. A black permanent marking pen and a steady hand provided the front panel lettering.

Random Wire Adapter

For most applications, I use random wires for an antenna—not a coax-fed antenna. My normal travel antenna is made from a 50-foot roll of 24-guage, two-conductor stranded speaker wire (RS 278-1301). I split the two conductors apart and terminated one end of each wire with a banana plug (RS 274-721) to provide a 100-foot dipole. To connect this dipole or any random wires to the QRP Delight, I built a random wire adapter (see Photo C) which plugs onto the output BNC connector (see


Photo E. Everything fits in a child's lunch box: 12 V 1.2 Ah gel cell, cables, charger, QRP Delight, home-brew keyer, HT-750 CW/SSB rig with a microphone and antennas.

Figure 2). This adapter consists of a SO-239-to-BNC male adapter (Radio Shack 278-120). A standard banana plug connects nicely to the SO-239 center conductor. For the ground, or counterpoise wire connection, I soldered a short wire terminated with an alligator clip to the outside screw-on shell of a PL-259 connector. Then I screwed the shell over the adapter. You can probably solder the wire/alligator clip directly to the adapter; however, I was not sure that I wouldn't melt the center dielectric of the adapter.

Parts List

1	3-15/16" x 2-1/16" x 1-5/8" plastic box	Radio Shack 220-231
2	335 pF variable capacitors	Radio Shack 272-1337 or Mouser
24TR218 w/two 48SS003 mtg screws		
1	One-pole 12-position rotary switch	Radio Shack 275-1385
1	DPDT toggle switch	Radio Shack 275-614
1	T130-6 (yellow core) toroid	Amidon Associates
2 feet	#24 enameled wire	
2	BNC chassis mount jacks	Radio Shack 278-105
1	100 µA miniature meter	Hosfelt Electronics, Marlin P. Jones & Associates, etc.
2	1k-ohm 1/4-watt resistors	
2	51-ohm 2-watt resistors	
2	100-ohm 2-watt resistors	
1	10k resistor	
1	10k miniature potentiometer	
1	1N34A germanium diode	
	Miniature microphone cable (Radio Shack 278-752) or RG-174 coax	

Note: Radio Shack no longer shows the variable capacitors in their catalog but some stores still have them in stock. The Mouser variable capacitor has two 266 pF sections. Just use one section of each variable capacitor for this application.

Conclusion

I operate QRP with two different rigs: a TS-50S at 10 watts output (OK—not really QRP!), and a Tokyo Hy-Power HT-750 at 3 watts output. The HT-750 is the most used since I can put a complete station in a child's plastic lunchbox (donated by my daughter—see Photo E), making it convenient for my business trips.

And how does the QRP Delight work? Great! I seem to be able to match anything I want to with it—even on 160 meters! I normally operate with the dipole described earlier, with each end of the dipole dangling from opposite sides of a hotel window. If my hotel room has a large floor-mounted air conditioner unit in it, I only dangle a single wire from the window and clip the alligator clip on the random wire adapter to the air conditioner. I have never used the QRP Delight above the 10-watt level due to the power resistor dissipation limits and the undoubtably low breakdown voltage rating of the variable capacitors. Build up a QRP Delight for the ultimate in low power size and flexibility.

DDS Dream VFO

Yes, you can build your own synthesizer!

by Steven Weber KD1JV

At last, here it is. The VFO QRPers and home-brewers have been dreaming of—a compact, standalone, Direct Digital Frequency Synthesizer VFO with LCD readout and push-button operation (see Photo A). Finally, your QRP rig with the frequency accuracy, stability, and features of your "BIG RIG." Before you wake up, take a look at these features:

- 0.0 to 25.000.000 MHz operation using Analog Devices' new AD7008 DDS chip
- Thirty character (16 x 2) liquid crystal display, back lighted
- Push-button control
- Frequency steps of 10 Hz, 100 Hz, and 5 kHz
- Direct frequency entry mode . . . to 1 Hertz
- Preprogrammed QRP frequencies for 80, 40, 30, and 20 M
- Ten user memories (stored in EEPROM)
- A/B MEMO memory
- Programmable receiver local oscillator with RIT
- Ten- to 30-WPM paddle keyer (2-wpm increments)
- Decodes and displays your outgoing Morse code
- FSK keying mode possible

Compact (4" X 4" X 1" module)

Photo A. The DDS Dream VFO.

Operation

It will only take a few minutes to learn how to use all the functions of this unit. Most operations involve pushing only one button. Storing or recalling a user memory takes two buttons. DFE (Direct Frequency Entry) takes up to 10 pushes of the buttons.

Programmable Offset Frequency

An offset frequency can be programmed to be used as a receiver local oscillator or for FSK keying. This offset is automatically added (or subtracted if the result is over 25 MHz) to the currently displayed (operating) frequency while in the receive mode (T/R line high). The offset can be any frequency up to 25 MHz. With the T/R line low, the output frequency is that which is displayed on the LCD.

For FSK operation, program the offset to the frequency shift needed. The T/R line is used to shift the output frequency. Since the offset is normally added to the transmit frequency, a high on the T/R input is the high frequency and a low is the low frequency. The FSK keying rate is limited only by the switching speed of the optoisolator. In this mode, the unit can only be used as an exciter.

Built-in Keyer!

The Paddle works automatically. As you start to key, the frequency output of the synthesizer shifts from receive to transmit and then keys your transmitter. The Morse you key in will be decoded and displayed in the first eight places on

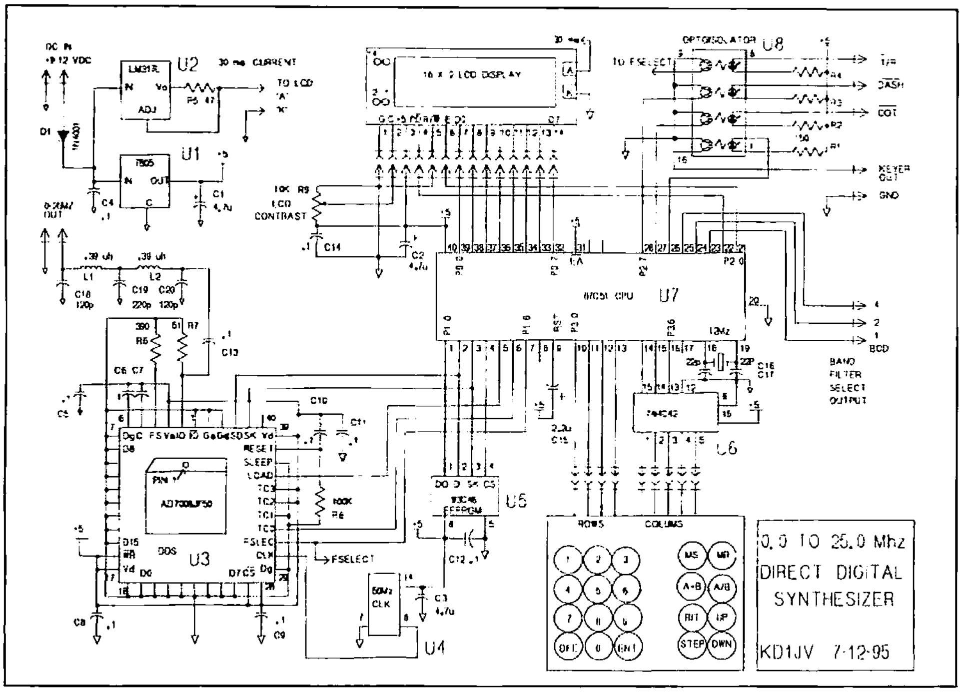


Figure 1. Direct Digital Synthesizer schematic.

the bottom line of the LCD. The VFO frequency will shift back to receive after a word space is detected, and the (Morse) display will clear after three word spaces.

I'll skip giving a detailed description of how all the buttons work. Operation, programming, expanded construction details, and mechanical drawings are supplied along with the programmed CPU chip.

Still dreaming? Lets find out more about this great new DDS chip from Analog Devices.

How It Works

Analog Devices really outdid themselves with this one. Completely integrated, enter 32-bit binary frequency data serially or with a 16-bit parallel data bus and get a sine wave of the desired frequency out of it. The chip includes a 10-bit DAC. It also includes two frequency registers that you can use to shift the output frequency in one clock period. To top it all off, the chip also includes two modulation registers that you can use to modulate directly AM or FM (phase) the output. Although the serial port can be used to load these registers, best performance (modulation rates up to 16.5 MHz) is obtained using the parallel data inputs. Put this chip on a card for your PC, modulate with digitized speech from Sound Blaster, and look out.

Because of the integrated 10-bit DAC, the spectral output of this chip is outstanding. Frequency spurs are typically 60 to 70 dBm down from the fundamental, and all are down at least 50 dBm. The signal output level is set to 1 V p-p. A simple 5-pole low-pass filter helps take the edges off of the stepped sine wave produced by the DAC. Because of the 0.1 µF cap used to couple the chips' output to the filter, the lowest audio frequency out into a 10k load is about 1000 cycles.

The frequency accuracy and stability of the output is solely determined by the DDS clock. The clock I used is CMOS and has a rated .005% frequency tolerance and a 100 ppm/C tempo. Typically, these parts perform much better than their specs imply. Frequency error and drift will be most noticeable at high frequencies. Below 10 MHz, drift and error will be almost nonexistent.

At a 50-MHz clock rate, this chip is fairly power hungry, drawing about 125 mA. It is also very expensive. Expect to pay about $60 for one.

A single-chip DDS deserves to be controlled by a single-chip MPU. I choose the 87C51 as it is readily available and easy to use.

A 93C46 serial EEPROM is used to store the frequency data. This little eight-pin dip can be written to at least 100,000 times and remember data for 40 years.

The "row" switches on the keypad are

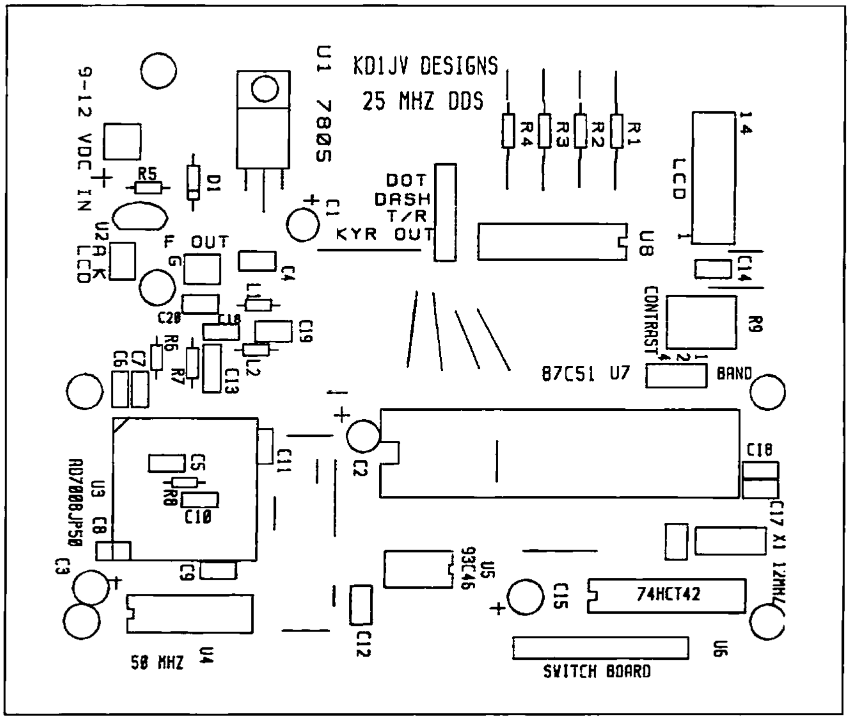


Figure 2. The main board, component screen.

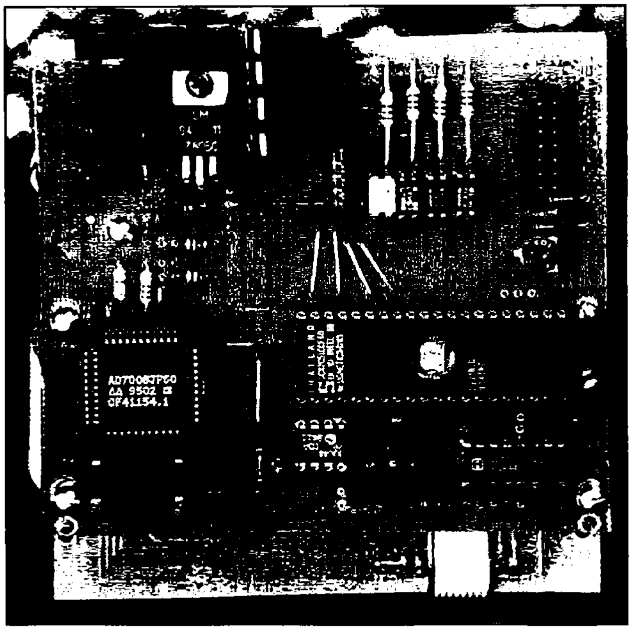


Photo B. The main board.

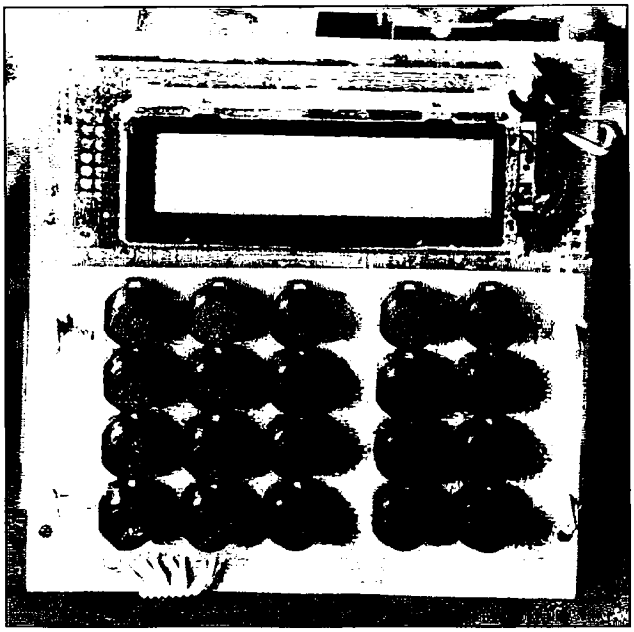


Photo C. Display and switch board, mounted to main board.

connected to port 3 of the MPU. The "columns" are scanned by using a 74HC42 binary-to-decimal decoder. This saves a few I/O lines.

Three outputs from port 2 contain band select information in BCD for automatically selecting a proper xmit or rcv filter on your rig for the current operating frequency.

The LCD data lines are connected to port 0 of the MPU. Enable (write) and P/D (program / data) control come from port 2. The display has 0.2-inch characters and is back-lighted LED. The back-lighting comes at a premium, but it is well worth the extra expense.

All inputs and outputs (except band) go through optoisolators. This ensures that you won't blow an input and have to replace the MPU for big bucks, and keeps RFI down to a minimum.

Power is supplied by a 7805 regulator, and a LM317L is configured as a constant current source to power the LEDs back-lighting the LCD.

Construction

The VFO is as easy to build as it is to operate. Experienced builders will have it up and running in less than an hour. It is best to build it on two printed circuit boards. See Figures 1–5.

Because the boards are single sided, there are a few wire jumpers to be installed. The only thing unusual is that one resistor and several caps (R8,C8,9,10,11) are installed on the solder side of the PC board. This was the only practical place to locate them and provide effective decoupling of the AD7008's supply leads. The AD7008, 87C51 and 93C46 are socketed. SIP pins and sockets are used to connect the LCD to the main board. The SIP pins mount with the long pins sticking out of the bottom (etch side) of the main board. The SIP socket is mounted on the bottom (component) side of the display.

The switchboard connects to the main board with a short length of ribbon cable (see Photos B and C). The display and switchboard mount over the solder side of the main board.

Threaded spacers support the display to the main board. Additional spacers mount the switchboard to the main board and to the enclosure. If a receiver is to be located in the same box as the VFO, mount a metal shield over the assembly.

The completed module is designed to mount into a 7" X 5" X 2.5" sloping panel metal box. Although other enclosures are possible of course, the sloping box makes it easy to read the display and push the tuning buttons.

A Couple of Warnings

Most all of the ICs are susceptible to ESD damage (electrostatic discharge). Make sure your work space is static-free; that is, wear only cotton clothes, avoid working on a nylon rug, and occasionally touch an earth-grounded metal object.

Second, the quickest way to destroy a CMOS IC is to power it up backwards. Make darn sure the chips are installed the right way before applying power. Also, once the DDS chip is pushed into its socket, a special tool is required to remove it (available at Radio Shack, thankfully). So try to get it right the first time!

Power up and Test

Once you are sure all the parts are installed correctly and have inspected for solder shorts or opens (especially around the plcc socket), it's time to "fire 'er up." You will need a 9–12 Volt @ 200 mA supply. The only adjustment is for LCD contrast. After power is applied, simply adjust the control for the best readability of the display. Ground the T/R input. In the transmit mode, the output frequency should be exactly the same as that which is displayed on the LCD. The VFO powers up set to 40 meters. The display should read "A 7.040,000 MHz" on the top line. The keyer speed "20" will be in the lower left corner. You should be able to hear this frequency on your station receiver or read it on a frequency counter. Now check out all the functions to ensure that they all work. Then program an offset frequency. All zeros will negate the effect of the T/R input. Connect the VFO up to your QRP rig and have fun!

If you have any problems getting the unit to work, suspect solder shorts. Inspect the board with a magnifying glass to be sure. Cracks in the copper PC tracks can also cause all kinds of weird problems.

Continued on page 18

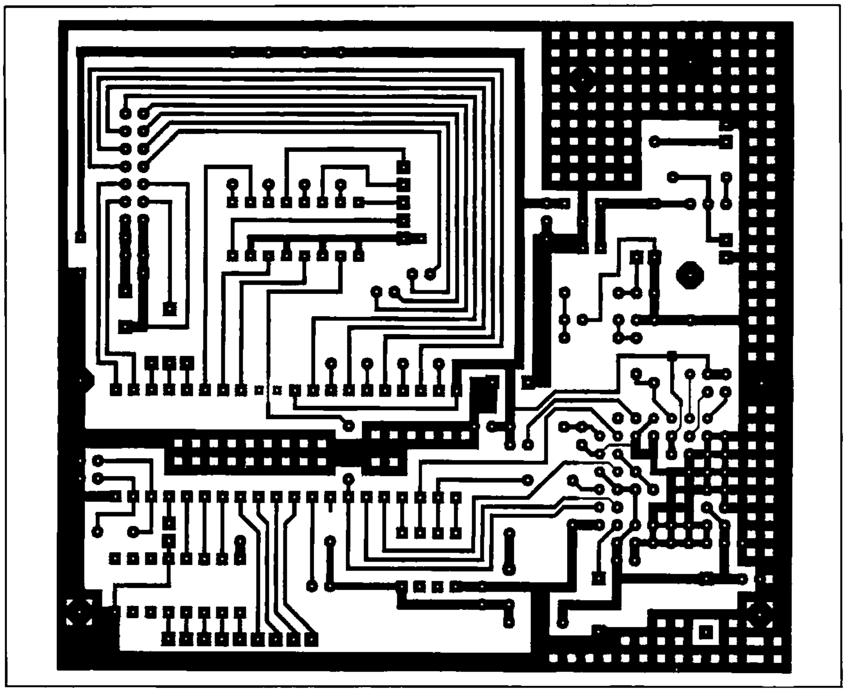


Figure 3. The main board, copper side.

DDS Dream VFO

Continued from page 16

Getting the parts.

Except for the DDS chip, all the parts are available from a combination of JDR Micro Devices, Digi-Key, and Mouser. I used Newark Electronics for the AD7008. They will ship COD. I can supply a programmed 87C51, the drilled and etched PC boards, as well as detailed operating and construction instructions for $50.00 pp. For a mere $225.00, get a complete kit with drilled and painted box. [Box 140, Gorham NH 03581]

Conclusion

Having all the controls for my rig on the desk next to my paddle has been an operating dream. Hope I never wake up. By the way, I'm developing a companion four-band, 5-watt transmitter and general coverage receiver (AM and CW).

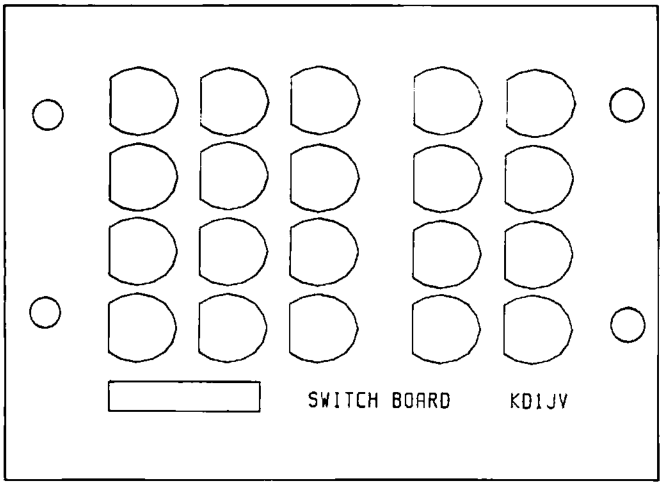


Figure 4. The switchboard, component screen.

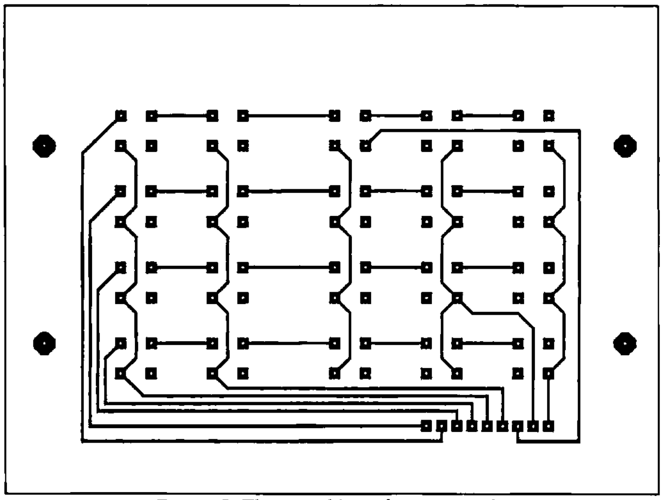


Figure 5. The switchboard, copper side.

Parts List

U1	7805	5-volt regulator
U2	LM317L	TO-92 adjustable voltage regular
U3	AD7008JP50	CMOS DDS MODULATOR
U4	SG-51KH50.0000	EPSON 50 MHz CMOS clock
U5	93C46	1K serial EEPROM
U6	74HCT42	bcd to decimal decoder
U7	87C51	4K MPU (must be programmed)
U8	551-PS2501-4	Quad Optoisolator (MOUSER)
LCD	509-GMD1620ALY	(MOUSER)
D1	1N4001	1-amp rectifier
C1-3	4.7 µF/10 V	Tantalum cap
C4-14	0.1 µF	ceramic mono cap .1" LS
C15	2.2 µF/25 V	Aluminum electrolytic radial
C16,17	22 pF	ceramic disk
C18,20	120 pF	ceramic disk, NPO
C19	220 pF	ceramic disk, NPO
R1-4	150 ohm	all resistors, 1/4-W, 5%
R5	47 ohm	carbon film
R6	390 ohm	
R7	51 ohm	
R8	100K ohm	
R9	10K	trimmer potentiometer Bourns 3316F series
L1,2	0.39 µH	molded miniature choke
SIP pins		
SIP socket		
Printed circuit boards		
20 Push-button switches		E-SWITCH, 520 series EG1411
X1 12 MHz crystal HC-49/US case		

Portable Solar Electric Power Generator

by Everett James K4SYU

Have you ever had the urge to get on the air and operate without having to plug the rig into a commercial, mechanical, or battery electrical power source? Well, if you would like to go this route for fun, or for Field Day, then try direct solar electric power. Here in sunny Florida, direct electric solar power works like a charm most of the time. And when it rains, who wants to be outside?

I built this solar power setup about two years ago and have used it many times at Ballard Park in Melbourne, Florida, and in my back yard in Satellite Beach. The solar panel has been used for battery-charging purposes. It has also been used to power my Heathkit HW-8 QRP Transceiver directly without a battery, and has provided electric power for many successful QSOs.

Photo A. The author with solar panel and HW-8 transceiver. Note the handle and the front cover on the panel.

After I have described how this panel is built, maybe you would like to mount your solar panel in a similar fashion. The design goals that I tried to achieve with this project were portability, protection from breakage, and ease of operation. This solar panel was manufactured by Chronar Corp., P.O. Box 177, Princeton, NJ 08542. The specifications state that it is a

"... if you plan to use it in a portable manner only in fair weather, as I do, then make a wooden frame as I have done."

solar amorphous glass panel with an output of 14.5 volts in full sun at 750 mA (500 mA is guaranteed). The size of the panel is 1' x 3' x 0.125". I purchased it at a local Hamfest. My electrical measurements indicate about 20 volts output with no load. The voltage is about 14.5 to 15 volts with a load of about 650 mA.

The panel, when purchased, was like a large pane of glass and just as fragile. Simply getting it home without breaking it was quite a chore. The vendor furnished a set of instructions, a small amount of solder, and two metal pigtails. Soldering the tinned copper pigtails to the panel was quite difficult. There were instructions for soldering, but the process is quite frus-

trating. My suggestion is to use a small electric soldering iron and sort of tin or puddle the solder on each of the edge plated strips at the top and bottom of the rear of the panel on one end. When you have a nice little puddle of solder built up on the plated strip, introduce the pigtail and solder it to the solder puddle. Set the panel in full sunlight and check the continuity by using a 10-watt, 25-ohm load. You should be able to measure approximately 14.5 volts and the resistor will get quite warm. If this checks out okay, then put a little epoxy over each of the solder connections in order to make a stronger mechanical bond. If you plan to leave the panel out in the weather, it is necessary to make a frame that is weather tight, using electrical-grade silicone sealant on the back with a Plexiglas rear cover, like a sandwich. But if you plan to use it in a portable manner only in fair weather, as I do, then make a wooden frame as I have done.

I used oak in constructing the frame, but pine would have been acceptable. The top and bottom rails and the crosspieces are 1.5" x .75". There are crosspieces at the center and at both ends. The area between the crosspieces is covered with ordinary 1/4" plywood on the back. I cut a 3/16" x 3/16" groove along one edge of the top and bottom frames. This groove is what holds the solar panel within the frame. The groove should be large enough to allow the solar panel to be slid in from the end, but should hold it securely. A little movement is okay as this allowed for expansion of the glass as the panel gets quite warm out in the sun. The wooden crosspieces are bolted to the top and bottom rails using 1/4-20 carriage bolts with nuts and washers on the back. The length of the top and bottom rails is 3 feet, which is the same length as the solar panel. All that is needed to keep the panel from sliding out of the groove in the rails is a wooden 1-1/4 by 1/4 wooden slat fastened on each end by wood screws that tie it to the end crosspieces. A carrying handle is attached to the top rail by wood screws. The output terminals, the voltage regulator, and the diode are attached to the right-hand end of the top rail. A heat sink is used with the voltage regulator and the wires to the panel go under the right-hand end slat and attach to the pigtails. A plywood front cover is mounted by two hinges to the bottom rail. A

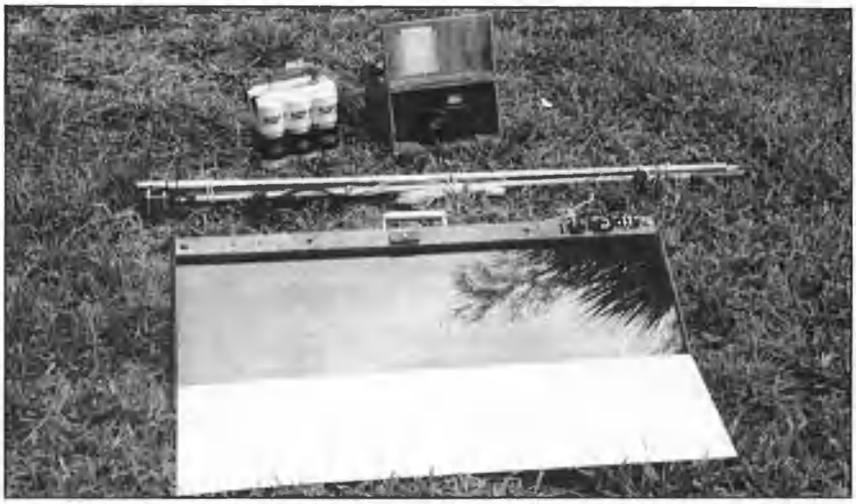
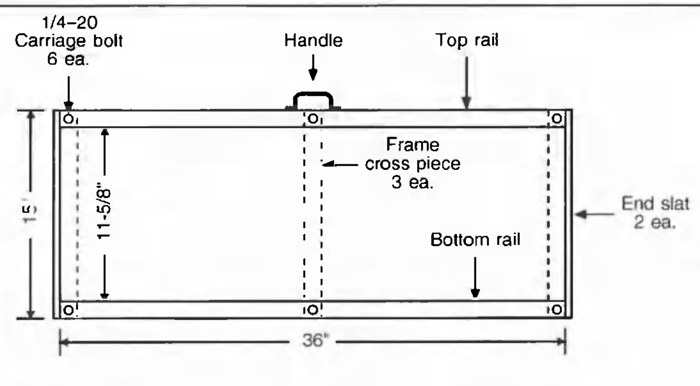


Photo B. The solar panel as used for battery charging. Shown is the panel, a portable quarter-wave vertical antenna, a lead-acid gel cell battery, and a Ten-Tec Argosy transceiver in its portable case.

Photo C. The HW-8 transceiver and the solar panel as used for QRP operations. Note the absence of a storage battery.



Front View of Panel

Figure 1. Totally solar-powered QRP station.

Parts List

- 10 feet ol 1-1/2- by 3/4-inch hard wood
- 7 square feet of 1/4-inch plywood
- 6 carriage bolts 1/4-20 and 2 inches long
- 2 machine bolts 1/4-20 and 2 inches long
- 6 hex nuts, flat washers, and lock washers for carriage bolts.
- 2 wing nuts with lock washers for machine bolts.
- 1 handle home-made aluminum
- 2 "U" shaped brackets from pipe hanger material.
- 2 aluminum pipe legs 8 to 10 inches long.
- 2 silicon diodes type 1N4002 or equivalent, 1 amp, 50 to 100 piv.
- 1 voltage regulator LM 340T-12 or LM 317T as available.
- 1 heat sink, aluminum, about 9 sq. inches.
- 1 resistor, 370 ohms, 1/2 watt.
- 1 resistor, approximately 50 ohms * 1/2 watt.
- 2 terminal strips with 2 screws each.
- 1 ceramic capacitor 0.1 uF.

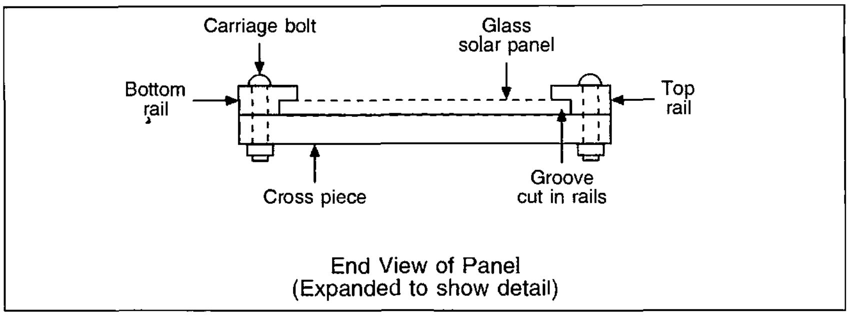


Figure 2. Front view of panel.

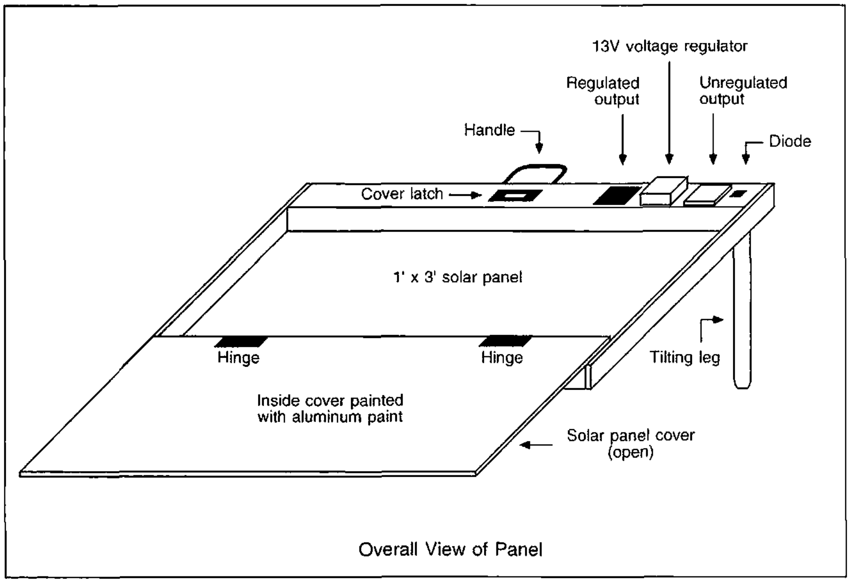


Figure 3. End view of panel (expanded to show detail).

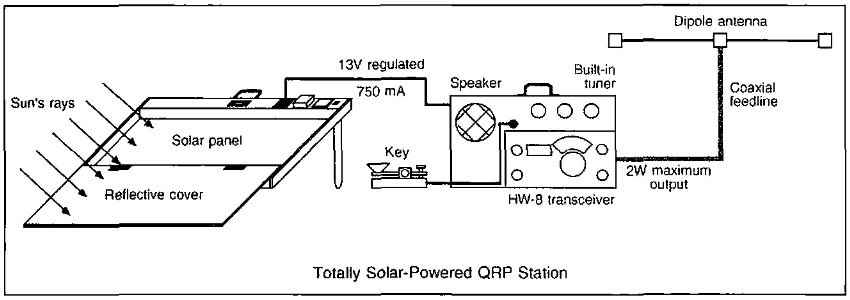


Figure 4. Overall view of panel.

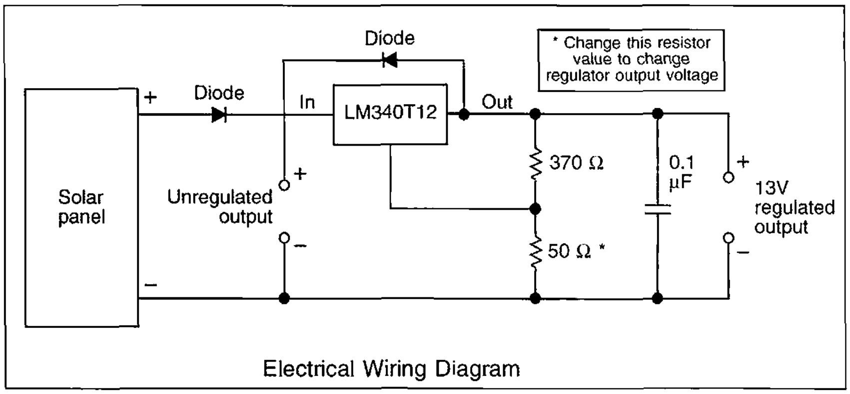


Figure 5. Electrical wiring diagram.

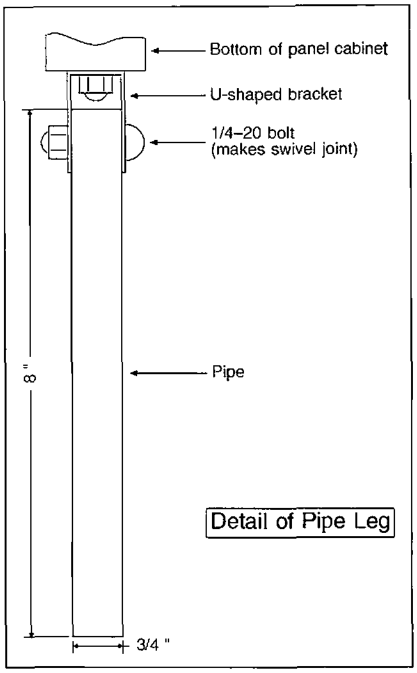


Figure 6. Detail of pipe leg.

simple latch is attached to the top rail in order to lock the cover in place while in transit. The inside of this cover is coated with bright aluminum paint. The cover not only protects the fragile panel, but also increases the efficiency of the panel by reflecting additional sunlight into the panel when the cover is open.

One additional item is needed. The panel must be tilted when it is set up for use in order to gather maximum sunlight. A pair of folding pipe legs are made of aluminum and attached to the rear cross pieces where the carriage bolts are attached. These legs are attached by home made "U" brackets and are about 8 inches long, and, when they are extended, the tilt of the panel is about 30 degrees from horizontal. The legs fold back when not in use.

"A LM 317T regulator could be used instead of the one I used."

The electrical hookup is as shown in the diagram. I used a type LM 340T12 three-terminal regulator and, by lifting the ground terminal and using a resistor network, I am able to get about 13 volts regulated output. I also placed a protective diode between input and output terminals in order to

protect the regulator while the battery is charging.

A LM 317T regulator could be used instead of the one I used. The diode between the regulator and solar panel prevents the storage battery from discharging back through the panel when the battery terminal voltage is higher than the output from the solar panel. The bypass capacitor is used to help keep RF energy from causing problems with the regulator and the solar panel. Furthermore, you could employ a lead-acid storage battery at either the unregulated or the regulated output terminals. The unregulated output charges quickly but could overcharge the battery. The regulated output charges more slowly, thus preventing overcharge, because as the battery voltage approaches 13 volts the charge rate slows down and finally almost stops.

Note: If your solar panel is larger or smaller than the one shown in this article, then it will be necessary for you to change the size of the rails and crosspieces to accommodate your panel.

> ***"This setup is ideal for Field Day operations with a small lead-acid storage battery to store the surplus electric power."***

This solar panel powers the HW-8 transceiver very nicely. as the current requirements for the HW-8 are 90 mA in receive mode, and 430 mA in transmit mode. It will probably power other similar QRP transceivers.

I find that QSOs can continue even though light clouds tend to obscure the sun. The power will start to drop off slightly but there is no sign of frequency instability or chirp, as the VFO in the HW-8 is stabilized at 9.1 volts. I have made many successful QSOs using just the solar panel, the HW-8, and a dipole antenna. When I tell the operator on the other end that I am solar powered, I am sure he does not realize that the signal he is hearing is generated by power directly from the sun at that very moment. This setup is ideal for Field Day operations with a small lead-acid storage battery to store the surplus electric power. Please do not use NiCds with this setup, as the charging current is not compatible with that type of battery.

I guess you know that if you operate as I do, without a battery, you automatically become a fair-weather ham. ■

Armstrong Updated

A high-performance, regenerative short-wave receiver

by David Cripe KC3ZQ

I have happily noticed that in recent years there has been quite a resurgence of interest in regenerative receiver circuits. It is not altogether surprising because it is one of the aims of any home-brew enthusiast to build equipment with performance close to that of commercial gear, but at a much lower cost. Regenerative shortwave receivers have been a perennial favorite project of hams, as they are one of the few projects in which a simple home-brew rig can approach the performance of a store-bought receiver.

Plenty of old-timers can remember that as late as the mid-1960s the *ARRL Handbook* and ham magazines contained numerous plans for regenerative sets intended for construction by the beginning ham or SWL. There are plenty of others (myself included) who got their start in radio by building simple regenerative rigs. The regenerative receiver, invented by Howard Armstrong back in the early part of this century, is a good choice for kit builders and home-brewers, as it is possible to obtain reasonably good receiver performance from a circuit that is simple enough for most folks to build for themselves.

History

A regenerative detector is nothing more than an antenna coupled to the resonant inductor-capacitor circuit of an RF oscillator. The oscillator serves as an RF amplifier, bandpass filter, and detector. By adjusting the amount of RF feedback within the circuit so that it is at the threshold of oscillation, you can render the sensitivity and selectivity of a regenerative receiver equal to that of a superhet receiver. Plus, the regenerative oscillator acts analogously to the BFO in a superhet, allowing reception of CW and SSB signals, in addition to AM.

So why aren't regeneratives more popular today? Well, regenerative receivers are not without their problems. My first regenerative set, as I recall, suffered from the shortcomings that have plagued most other regenerative receivers. The receiver had an annoying audio oscillation that would occur at some settings of regeneration. It was very sensitive to hand capacitance; once you removed your hand from the tuning knob, it would shift the tuning frequency off station. Also the regeneration control was not smooth. While being adjusted, it would pop abruptly in or out of oscillation, making it difficult to find the "sweetspot" of maximum sensitivity at the threshold of oscillation. The circuit would not regenerate at all positions on the band. And had there been any other hams in my neighborhood at that time, they would have reported another problem with my receiver. Most regenerative receivers radiate an RF signal at the frequency to which they are tuned, creating QRM for anybody else listening on that frequency. As a result of these phenomena, the regenerative receiver, which was the preferred technology for AM broadcast receivers through the 1920s, lost out in favor of one of Howard Armstrong's other inventions: the more expensive and complicated superheterodyne.

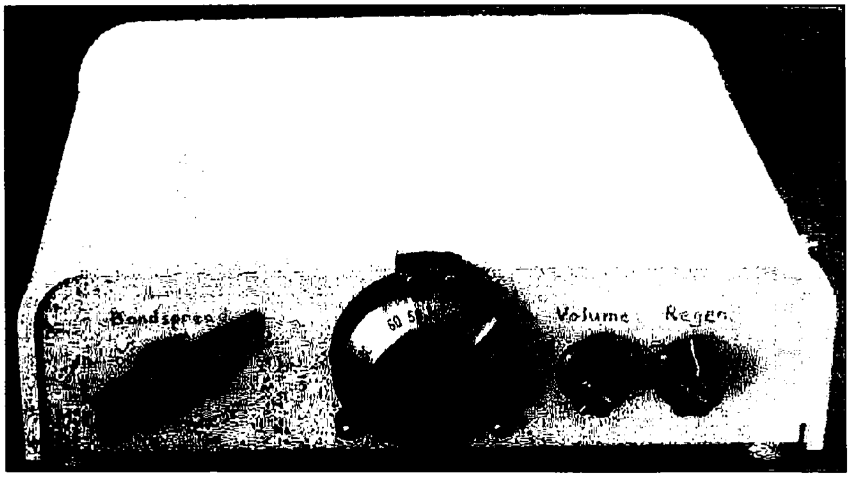


Photo A. The completed Armstrong Updated regenerative receiver.

Correcting the Flaws

I have always thought that if these problems with Armstrong's regenerative receiver could be corrected, a portable regenerative shortwave receiver would make a great home-brew project. In the past dozen or so years, I've probably breadboarded 10 different experimental designs, some of them frankly quite horrible, but each providing new insight into the causes and cures of these problems. I finally arrived at a design that performs nicely, is well behaved, and is not overly complicated to construct (see Photo A).

Figure 2 shows the schematic of the circuit. There are a number of unique features in this design that give it its trouble-free performance. The tendency for regenerative receivers to radiate oscillator-frequency signals is eliminated here by placing a transistor buffer Q1 between the antenna preselector circuit L1-C1a and the regenerative oscillator-tuned circuit L2-C1b. This buffer also nearly eliminates hand-capacitance effects.

This design is also unique in that it uses an IC for the regenerative detector. U1, an LM1496 double-balanced mixer, is used here in a somewhat unorthodox manner. The differential "Signal Input" amplifier transistors internal to the IC are used as a Hartley oscillator in conjunction with L2

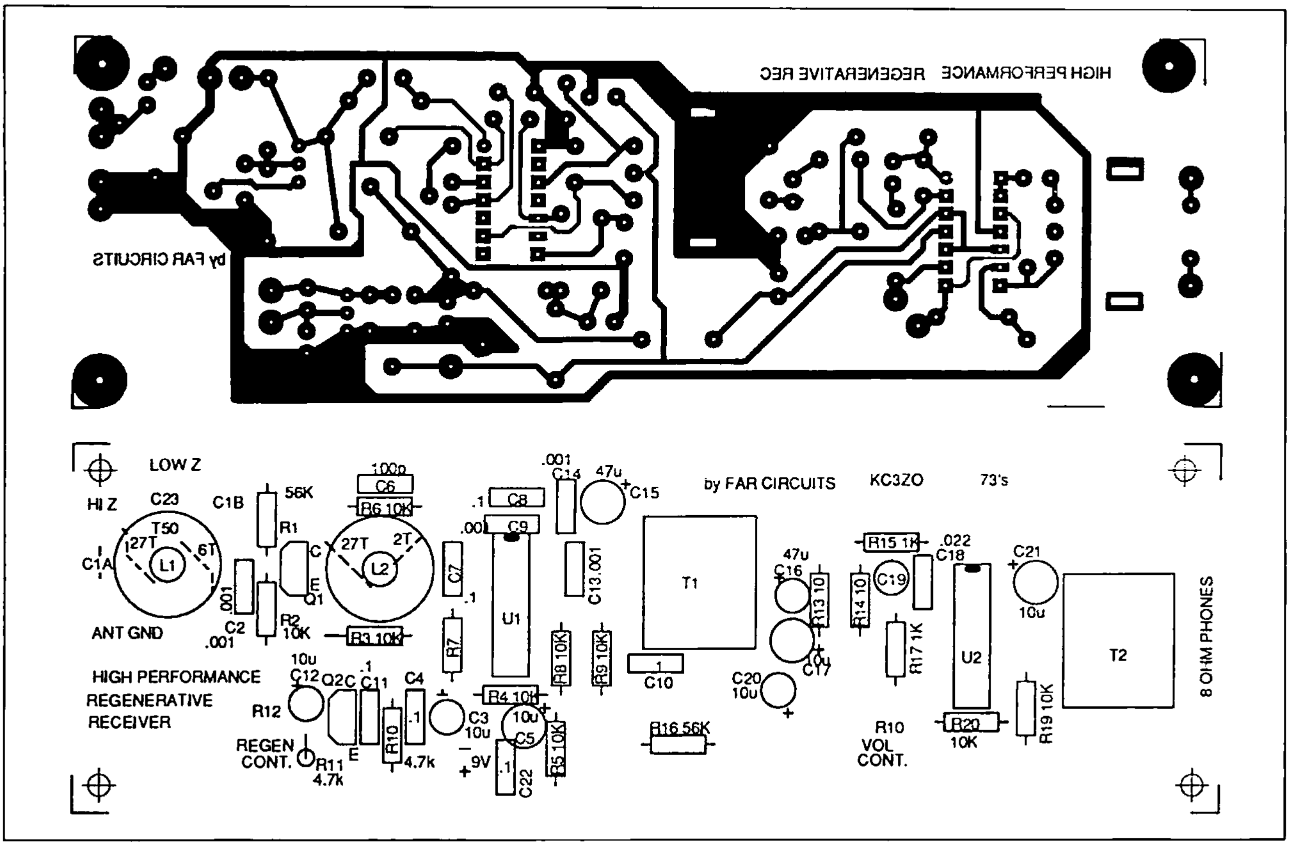


Figure 1. Printed circuit board layout (FAR Circuits).

and C1b. The regenerative feedback for this oscillator is supplied by the output of the "Gain Adjust" pins of the LM1496. Some of the oscillator output is coupled to one of the "Carrier Input" pins via C9, which allows the mixer section of U1 to act as asynchronous detector, greatly improving the RF detection sensitivity over that of other regenerative circuits. The regeneration level is controlled by the voltage level applied to the "Bias" pin of U1. The circuit containing R12 and transistor Q2 is used as a variable voltage source, providing the regeneration level immunity from supply voltage ripple. This bias level controls the quiescent current level through the "Signal Input" amplifier transistors, which in turn determines the emitter-output-impedance of these transistors, controlling the amount of power delivered to the feedback winding of L2. This results in a very smooth and predictable regeneration control.

The outputs of U1 are coupled through audio transformer T1 into the first section of U2, an LM324 op amp. This first section is configured as an audio bandpass filter, rolling off the audio response below 300 and above 3,000 Hz. Volume control is achieved through U2d and variable resistor R18. The output of U2d is buffered by U2b and U2c, which provide a push-pull output for audio transformer T2, giving us headphone-level audio into 8-ohm phones. The audio oscillation encountered in many other regenerative receiver designs is due to supply voltage ripple coupling into their high-gain discrete-transistor audio amplifiers. Op amps have very high rejection of supply voltage ripple effects, so they have much better immunity to this oscillation phenomenon. Using a push-pull audio output stage, as is done here, also reduces susceptibility to audio oscillation.

The only compromise in this design was the choice to make it a single-band receiver. Although the use of switched or plug-in coils could have allowed multiband reception, in the interest of simplicity this was not done. However, the values of L1 and L2 allow coverage of 5 to 15 MHz, where much of the shortwave action occurs.

Construction

There are two antenna terminals provided. The "Hi Z" connection is for short an-

Photo B. Under the hood of the Armstrong Updated receiver.

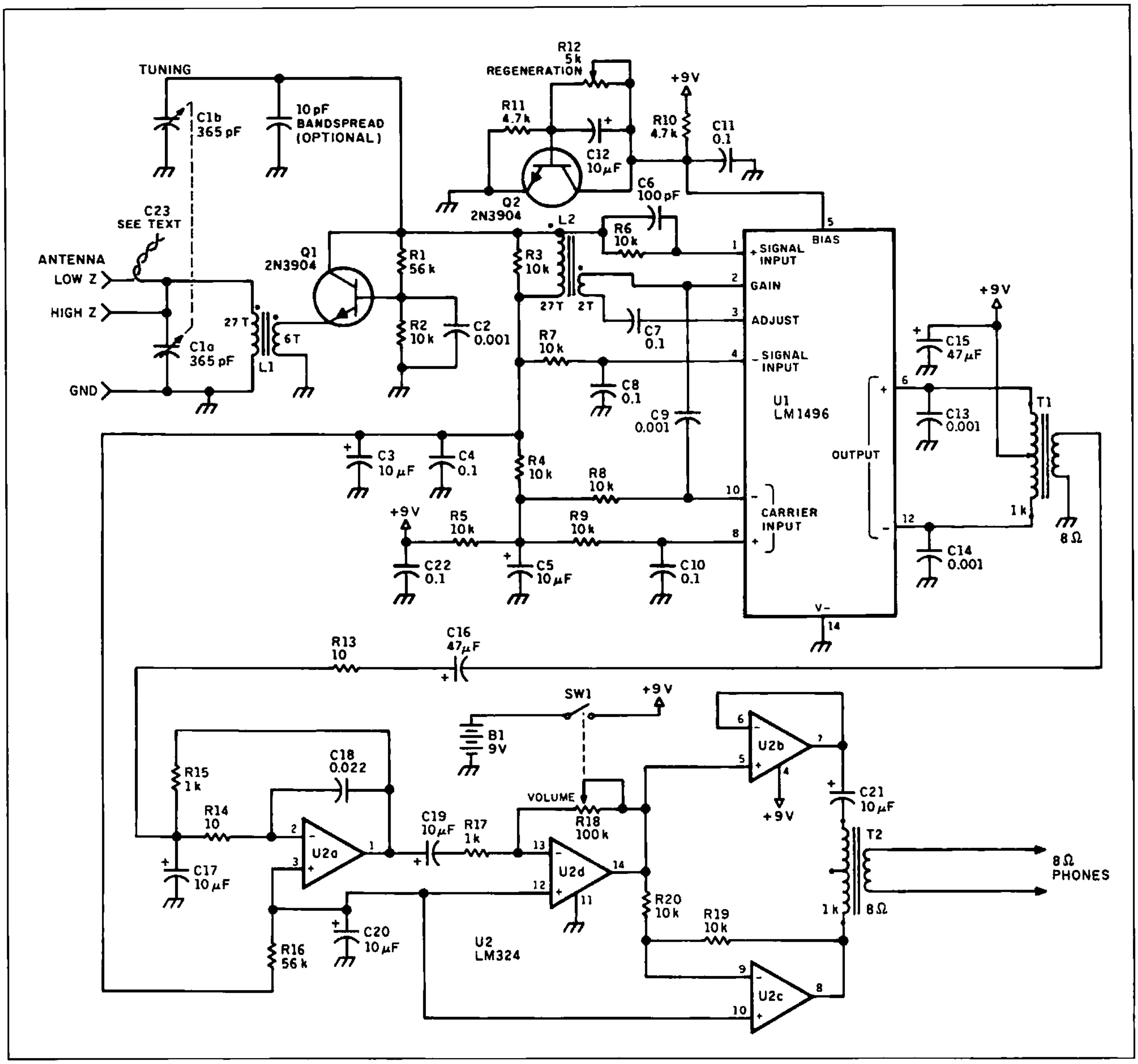


Figure 2. Schematic diagram for the Armstrong Updated regenerative receiver.

tennas, and the "Low Z" connection is for antenna wires greater than roughly 3 feet in length. The "Low Z" antenna terminal couples energy into the preselector circuit through a C23, a "gimmick" capacitor constructed out of two 1" pieces of insulated wire twisted tightly together. This helps prevent overload of the RF circuitry, which might occur from more powerful stations. Experiment for best results.

The inductors L1 and L2 are wound on Amidon T-50-2 iron-powder toroids. The primaries of each consist of 27 turns of #30 magnet wire distributed evenly around the core. The secondary of L1 consists of six turns of #22 gage stranded, insulated hook-up wire. The secondary of L2 consists of two turns of #22 hookup wire. Try to keep these windings short and direct to the circuit board.

The tuning of the receiver is done with variable capacitor C1a and C1b. Using a dual-gang capacitor makes the tuning of the antenna preselector and the regenerative oscillator track automatically. It may be difficult to obtain dual-ganged 365 pF variable capacitors, but check at your next hamfest, or with surplus dealers such as Fair Radio Sales. The value of these variables could be larger than 365 pF and still work well. Otherwise, two separate capacitors could be used. It is also very helpful to use a vernier drive on the tuning capacitor, so that closely spaced stations can be separated. Optionally, a bandspread capacitor, a 10 or 20 pF variable, can be added in parallel with C1b. Use whatever you can find.

With the relatively small quantity of components used here, I was able to construct the entire receiver on one of Radio Shack's solder-pad perf boards, #276-168. Alternately, dead-bug construction techniques could be used to construct the circuit on a piece of blank, copper-clad PC board material approximately 3" by 4". For ease of construction, a drilled and etched PC board (Figure 1) is available for $6 plus $1.50 S & H per order from FAR Circuits, 18N640 Field Court, Dundee, IL 60118.

Finally, mount the entire assembly in a metal enclosure (see Photo A). This will provide additional shielding against oscil-

lator radiation and hand-capacitance. It takes some extra work over that of a breadboard layout but is worth it. I also recommend mounting the PC board with a 1/2"-thick piece of foam rubber sandwiched between it and the chassis, using double-sided adhesive tape. This helps reduce any tendency for microphonics.

The only potentially tricky part in assembling this project lies in getting the secondary of L2 wired in the proper direction. Connect a short (one foot is fine) antenna to the "Hi Z" antenna terminal, turn on the power to the unit, then advance the volume control to its midpoint while listening to the output on your headphones. Slowly rotate the "Regeneration" control from one end of its range to another. You should notice at some point in its travel a fairly abrupt increase (or decrease) in audio noise in the phones, indicating that oscillation has begun. If the noise level in the phones remains constant while rotating the "Regeneration" control, you probably have L2's secondary wired in reverse. Swap the ends of the winding, and try again. If there is still no change, try increasing the number of turns on the L2 secondary from two to three, and repeat.

In operation, the receiver is surprisingly sensitive. With a 1-foot antenna and no ground, I was able to pick up over 2 dozen broadcasters. With the regeneration control at the threshold of oscillation, the selectivity was such that there was no adjacent channel interference, and the headphone volume was more than adequate. Pretty impressive for 80-year-old technology! I would like to think Howard Armstrong would approve.

Notes

Vernier drives are available through Mouser and Fair Radio.

Mouser stocks a dual-ganged 266 pF miniature variable cap,#24TR218, which may be used with the same frequency coverage if the primaries of L1 and L2 are increased to 32 turns each.

56k resistors and the LM1496 are available through Mouser, DigiKey, or on special order through Radio Shack.

Sources

Amidon
12033 Otsego St.
North Hollywood CA 91607
(310) 763-5770

Digi-Key
701 Brooks Ave. South
P.O Box 677
Thief River Falls MN 56701
(218) 681-6674

Fair Radio Sales
1016 E. Eureka
Box 1105
Lima OH 45802
(419) 227-6573

FAR Circuits
18N640 Field Court
Dundee, IL 60118

Mouser Electronics
11433 Woodside Ave.
Santee CA 92071
(817) 483-0165

Parts List

Part #	Value	RS #
All resistors 1/4 W unless noted.		
R1, 16	56k	See below
R2-9, 19, 20	10k	271-1335
R10, 11	4.7k	271-1330
R12	5k Var. Audio	271-1720
R13, 14	10 ohm	271-1301
R15, 17	1k	271-1321
R18	100k Var. Audio	271-1722
C1	365 pF, 2-gang variable	See below.
C2, 9, 13, 14	0.001 µF	272-126
C3, 5, 12, 17, 19-21	10 µF 'lytic	272-1025
C4, 7, 8, 10, 11, 22	0.1 µF mono ceram.	272-109
C6	100 pF	272-123
C15, 16	47 µF 'lytic	272-1027
C18	0.022 µF	272-1066
Q1, 2	2N3904 or equiv. NPN	2762016 or 276-1617
U1	LM1496 balanced mixer	See below
U2	LM324 Op amp	276-1711
T1, 2	1k:8-ohm audio xfmr	273-1380
L1	Amidon T-50-2 Primary: 27 turns #30 wire Secondary: 6 turns #22 wire	
L2	Amidon T-50-2 Primary: 27 turns #30 wire Secondary: 2 turns #22 wire	
S1	SPST pot switch, mounts on R18	271-1740

A Note from Wayne Green W2NSD/1

One of the first really popular ham receivers was the National SW-3, a regenerative receiver. That was state-of-the-art in the early 1930s when I first got involved with amateur radio. My first ham building project was the RSR receiver, which was regenerative on the shortwave bands and super-regen on the VHF bands. When I was assigned to the *USS Drum* (SS-228) in 1943, we still had regenerative receivers for the lower bands. Eventually I got superhets to replace them, but you'll notice when you visit the *Drum* in Mobile that the old regenerative receivers are back in place. Also check out the plaques with stories about our patrol runs. I wrote those stories, and the whole series is available from Uncle Wayne's Bookshelf for $7.50.

Link it All!

Why settle for operation on just two bands?

by Klaus Spies WB9YBM

The modern generation of dual-band radios has shown us the benefits and convenience of being able to operate on two VHF or UHF bands at once. But why limit yourself to just two bands? Here's a way to increase the benefits, as well as the fun, of operating multiple VHF and UHF bands all at once.

To obtain a signal from a receiver that indicates a positive voltage (logic 1) when a signal is received, you can use the receive indicator (usually an LED), or obtain a signal from a transceiver's squelch[1]. Figure 1 shows one easy approach to adding an interface to your transceiver.

Figure 1 also illustrates the basic concept of linking two transceivers; not shown (but to be added later as desired/required) are optional timers to avoid noise bursts randomly toggling on a transmitter, combined with a hang-timer[2].

Figures 2 and 3 show how you can use logic gates to add more transceivers into a link, including a way of figuring out how many gates are required for the quantity of transceivers (and options) in an entire system. Examples of options include local microphone/speaker, IDer, and autopatch. This approach is wired so that if any one input (receiver, local

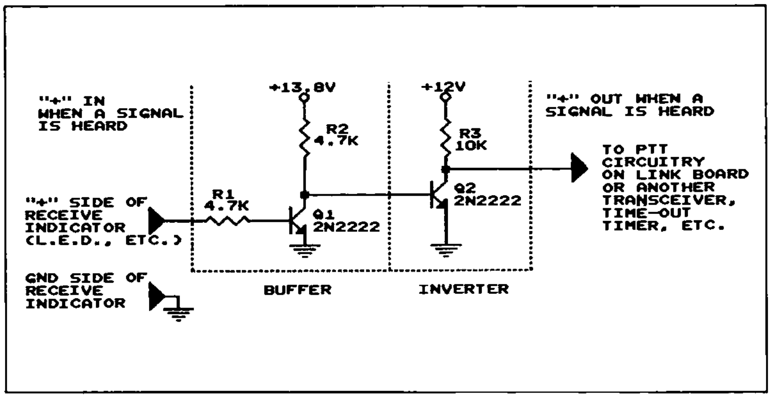


Figure 1.

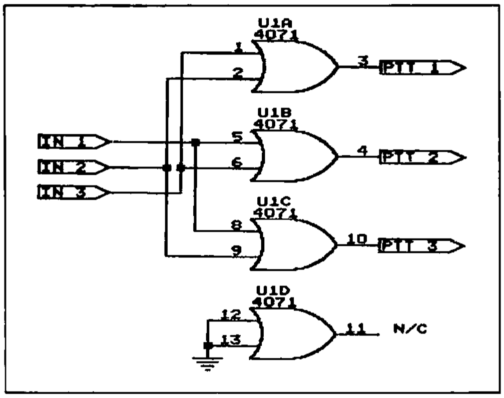


Figure 2.

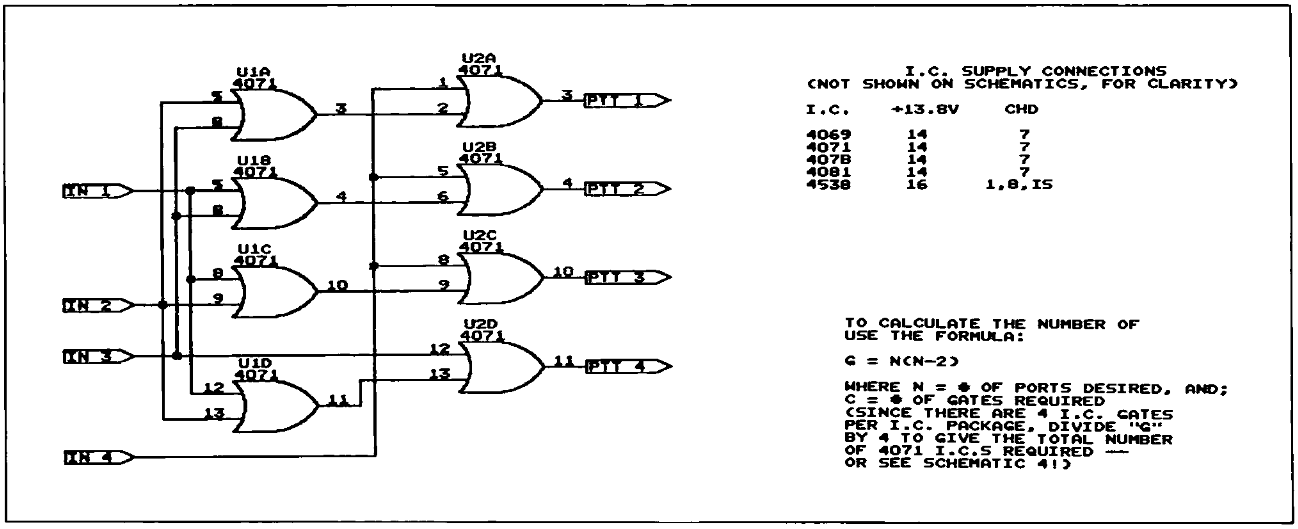


Figure 3.

microphone, and so forth) becomes active, all but that one corresponding output become active.

For my prototype, I used 4078 NOR gates and inverters (since we're dealing with positive logic) to simplify the wiring and to keep the parts count low (see Figure 4).

The final requirement is an audio combiner, shown in Figure 5. I've noticed some audio distortion in certain transceivers if the audio gain (volume) is set too low; therefore, I set the volumes of my transceivers at about the half-way point, and use boost/cut control in the operational amplifiers in the combiner to set the volume controls.

If you plan to be away from your link enough to make it a concern, a simple time-out timer[3] can be added in almost any convenient spot (for each transmitter, after each receiver that eliminates only the one receiver hung up due to noise, or at other convenient spots in the circuitry). ■

1. "Midland 13-509 Modifications," *73 Amateur Radio Today,* December 1988, p. 27.
2. "Ending Transmit Chatter," *73 Amateur Radio Today,* February 1991, p. 27.
3. "PTT Time-Out," *73 Amateur Radio Today,* August 1990, p. 82.

Schematics by Klaus Spies WB9YBM

Parts Sources

1. Digi-Key Corporation, 701 Brooks Ave. S, Thief River Falls, MN, 56701; (800) 344-4539, fax: (218) 681-3380.
2. Tri-State Electronics, 200 W. Northwest Highway, Mount Prospect, IL, 60056; (708) 255-0600, fax: (800) 255-0526.

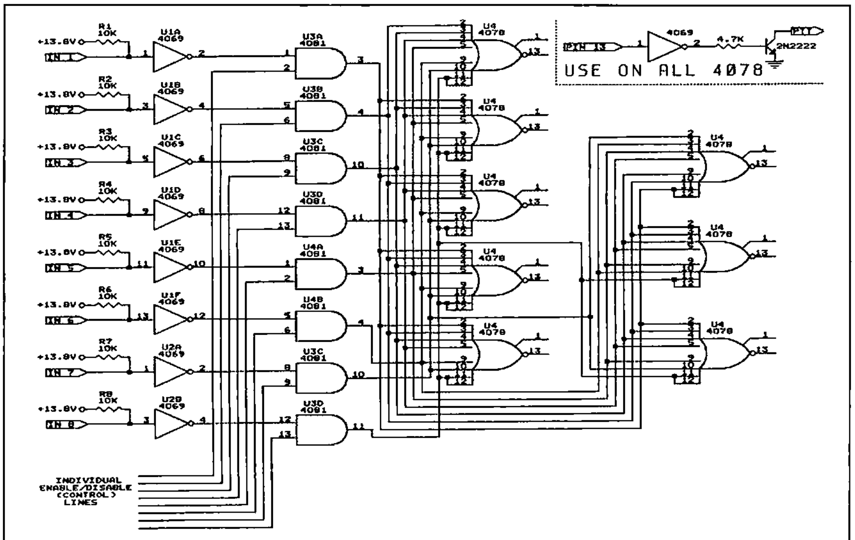


Figure 4.

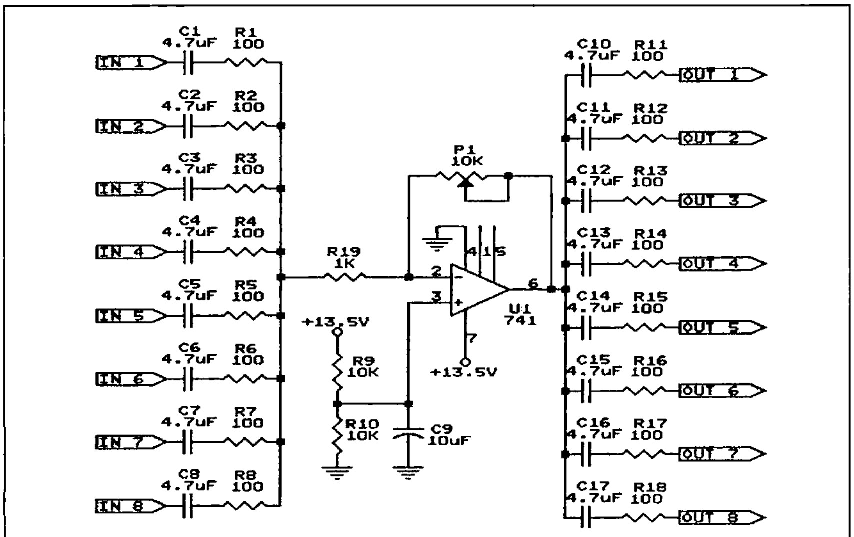


Figure 5

Boring Beacons!

Making additional use of beacon signals.

by D. R. "Kuby" Kubichek N6JSX

Amateur Radio has set aside dedicated portions of various bands for radio beacons which typically broadcast the operator's callsign in CW on a low-power omnidirectional antenna. A beacon's *only* recognized purpose is to evaluate radio wave propagation on a specific frequency from a specific location. But beacons can do double duty—being an RF source for monitoring propagation and also transmitting telemetry information. The beacon telemetry can be in the form of varying audio tones that can disseminate public safety information in the form of wind speed, seismic energy, or even area weather warnings! A beacon could even transmit Morse code practice.

The Midwest and South have tornadoes, the East and Gulf Coast have hurricanes, and the West has earthquakes and volcanic activity as major natural threats. There is no reason why radio beacons can't transmit useful and possibly lifesaving information while they send their regular transmission.

Until I built my Seismic beacon, I may have listened to beacons for a total of 15 minutes over 22 years of hamming. How many of these read-

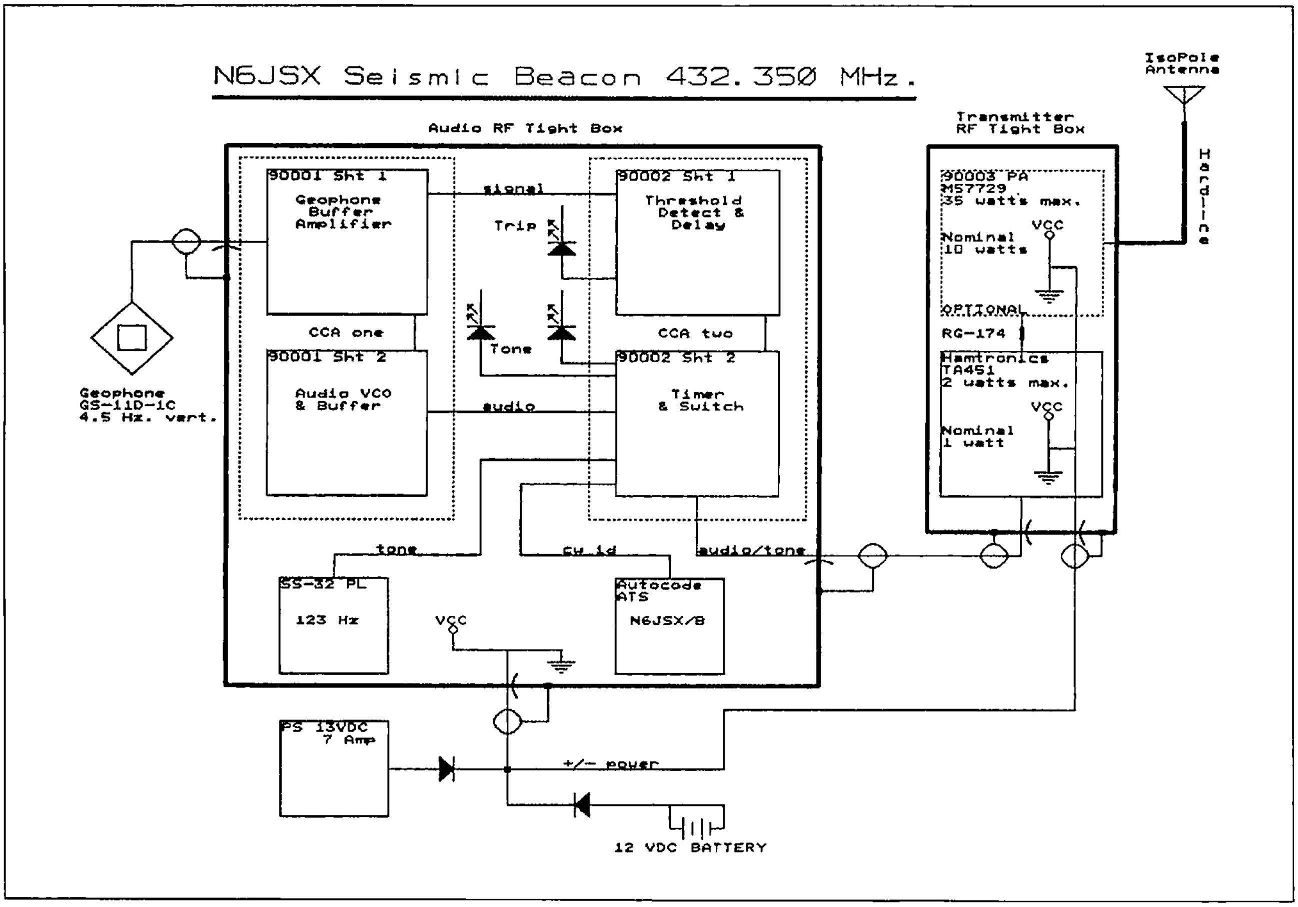


Figure 1. System Interconnect Diagram.

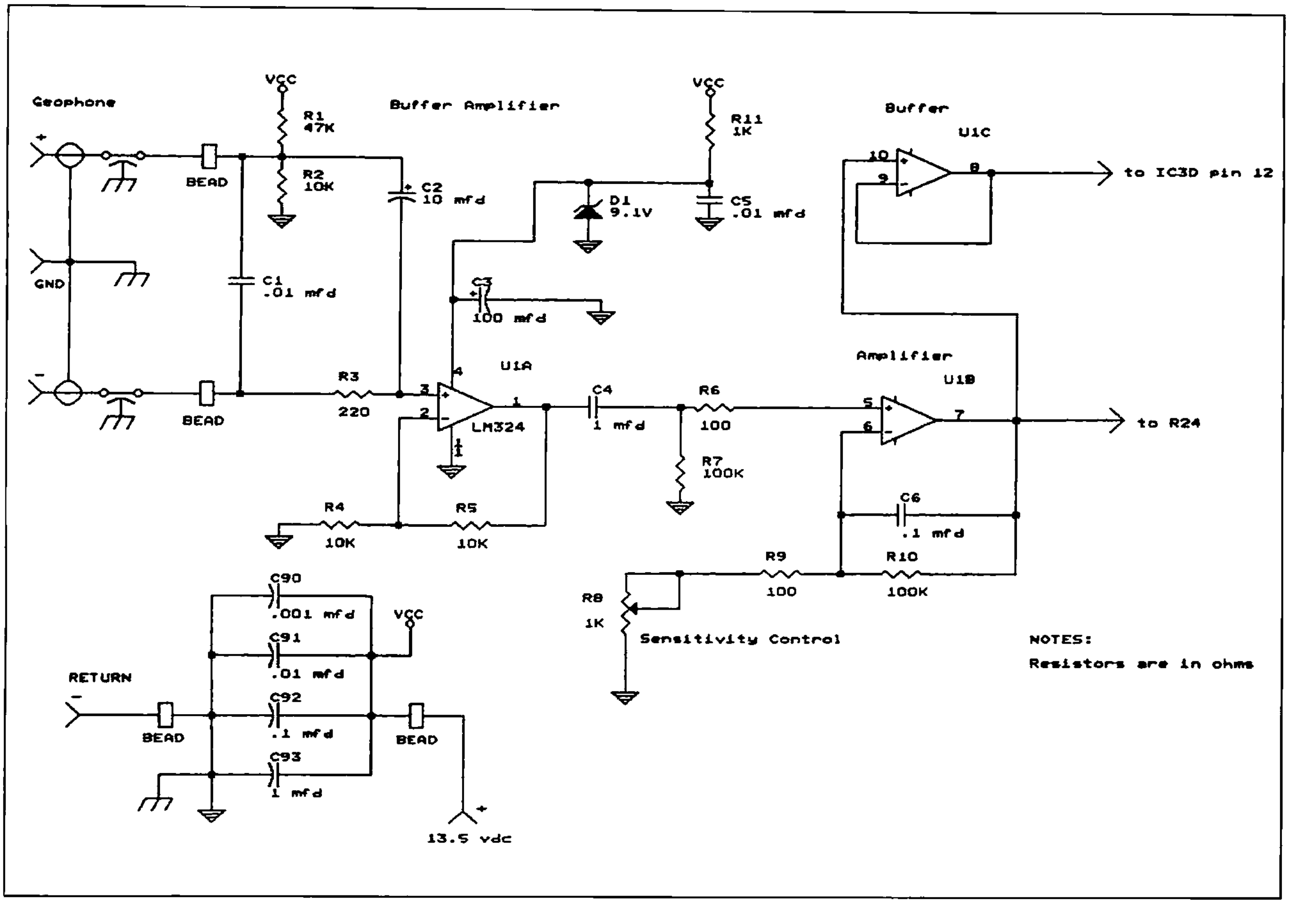


Figure 2. Geophone Buffer Amplifier.

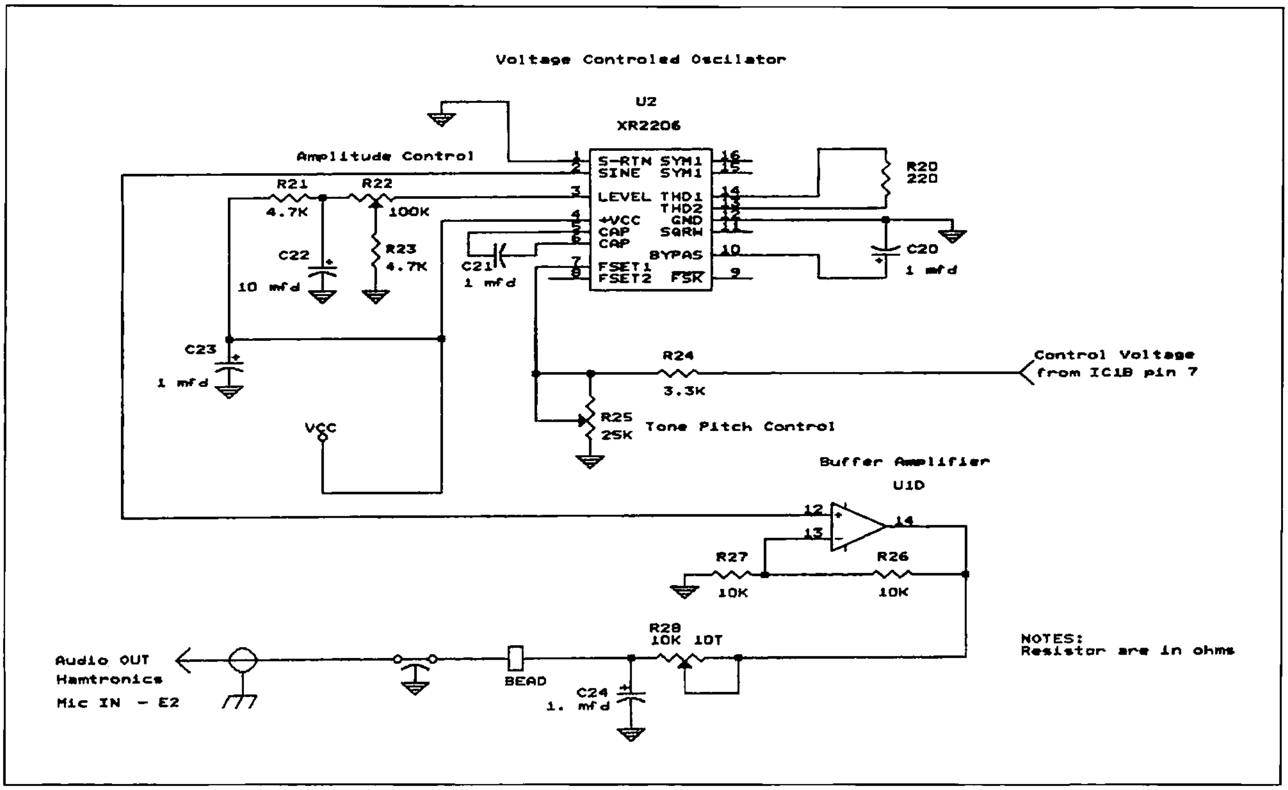


Figure 3. Audio VCO and Buffer.

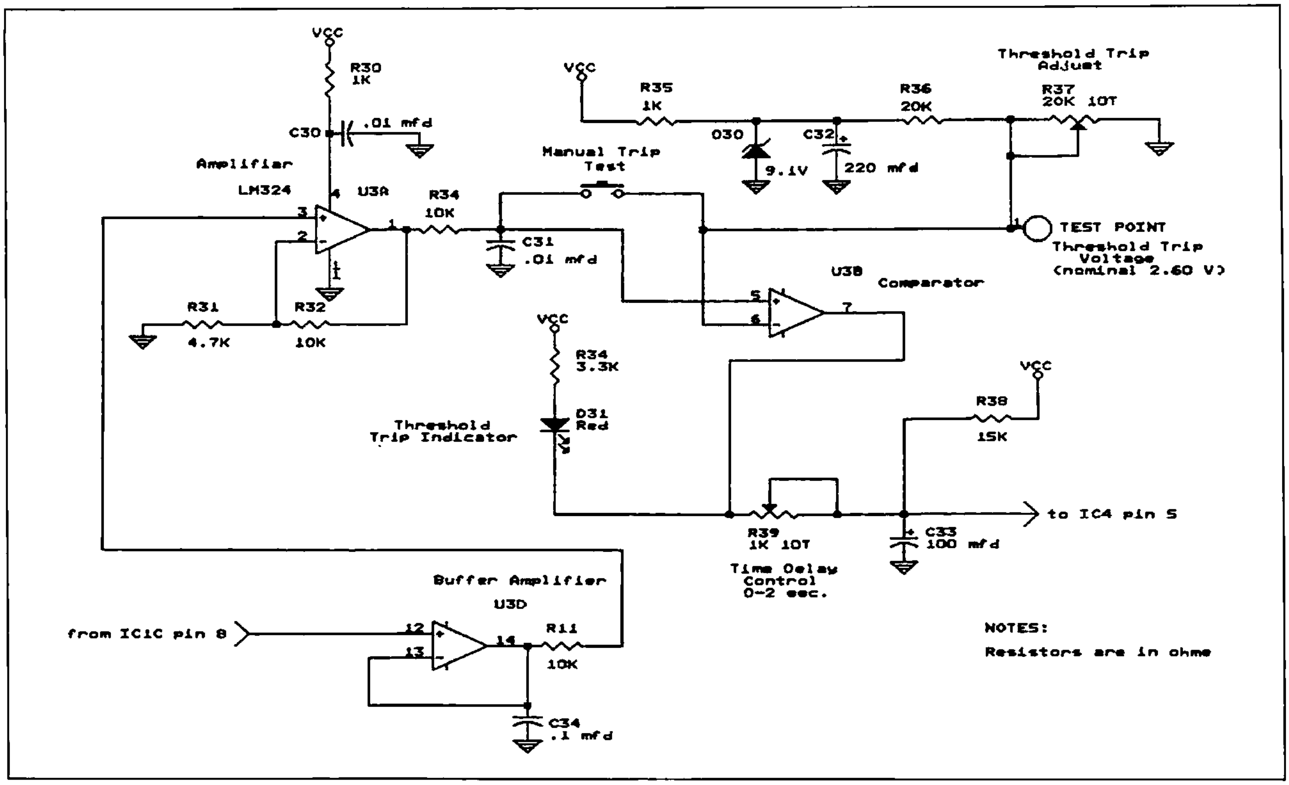


Figure 4. Seismic Threshold Detect and Delay.

Continued on page 38

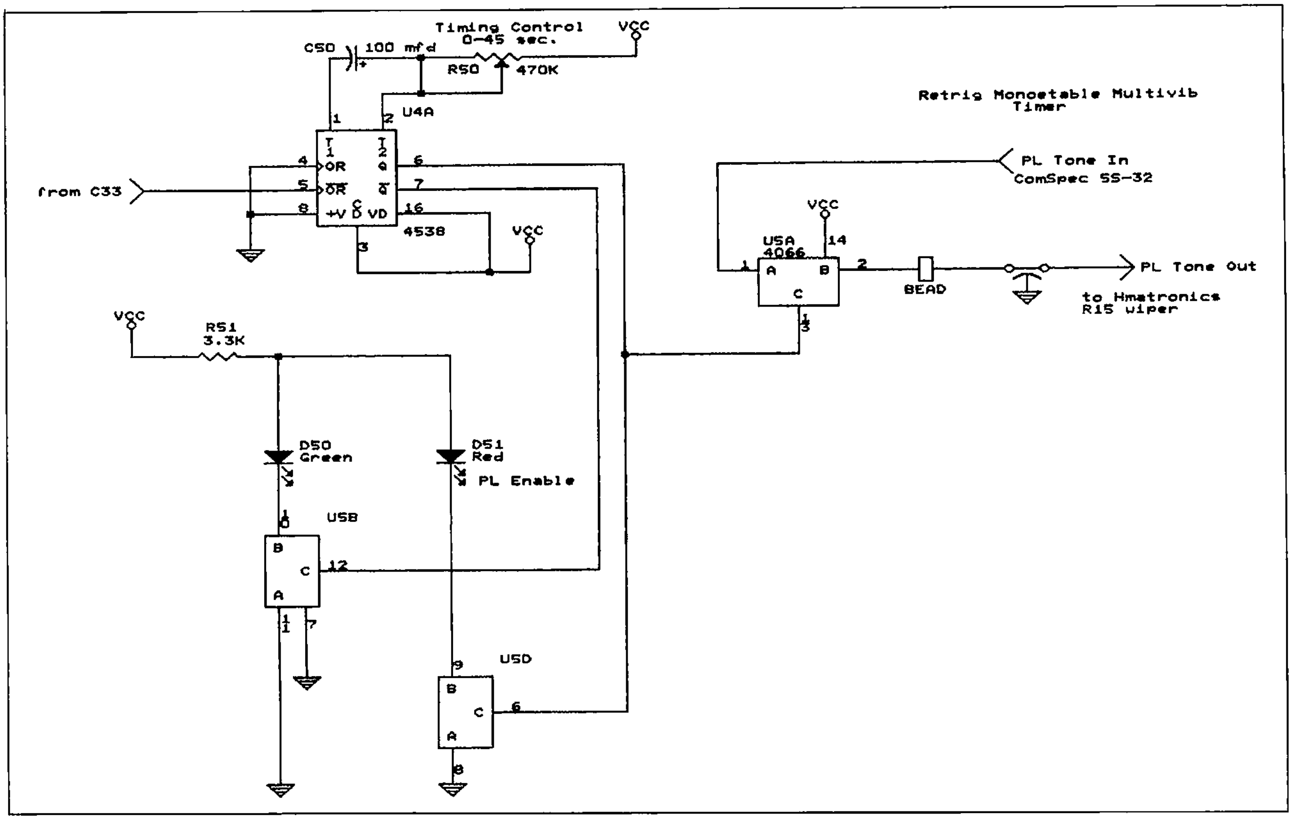


Figure 5. Timer and Switching.

Continued on page 40

ers have ever listened to a beacon? How many of you can even copy the CW ID? Do you know where beacons are located and their operating parameters?

I built my Amateur Radio Beacon primarily as a radio seismometer that runs at 2 to 10 watts covering the Los Angeles area on 432.350 megahertz, and this beacon could be used for propagation evaluation. My ID cycle is set for a 9.5-minute intervals, but the beacon transmits a constant tone near 680 hertz that varies proportionally to any amount of seismic energy sensed by a geophone sensor. The sensor is so sensitive I could distinguish between a loaded or an unloaded train moving three-fourths of a mile north of my home.

When seismic energy is detected that exceeds a preset threshold, a subaudible tone is injected onto the beacon's signal. (This optional subaudible tone was added to reduce the detection in the listener's circuitry.) Threshold level appears to indicate events equal to or greater than 3.0 on the Richter scale in my local area. Event threshold detection is typically T + 0 to 2 seconds of delay.

Some Los Angeles VHF and UHF repeaters have expressed an interest in monitoring this type of beacon. With an auxiliary receiver at the repeater site that could detect the subaudible tone, the repeater could either sound a warning tone or retransmit the beacon's audio. The repeater users would get some amount of seismic warning.

This beacon only reacts to actual released seismic energy and is not per se a prediction device. However, if a quake slowly starts releasing energy before the major shock, the beacon could give listeners some forewarning. Many small earthquakes over a short period of time (called seismic swarms) can indicate an increased probability of a large, pending earthquake. Listeners can monitor and judge for themselves how they want to react to the seismic activity. Mobile users could make a quick decision whether to travel under the next freeway overpass or pull to the shoulder. I personally consider any amount of earthquake forewarning better than no warning!

Amateurs who live in earthquake-prone areas could create an overlapping network of seismic beacons. I hope that sharing my beacon

> ***"Many small earthquakes over a short period of time (called seismic swarms) can indicate an increased probability of a large, pending earthquake."***

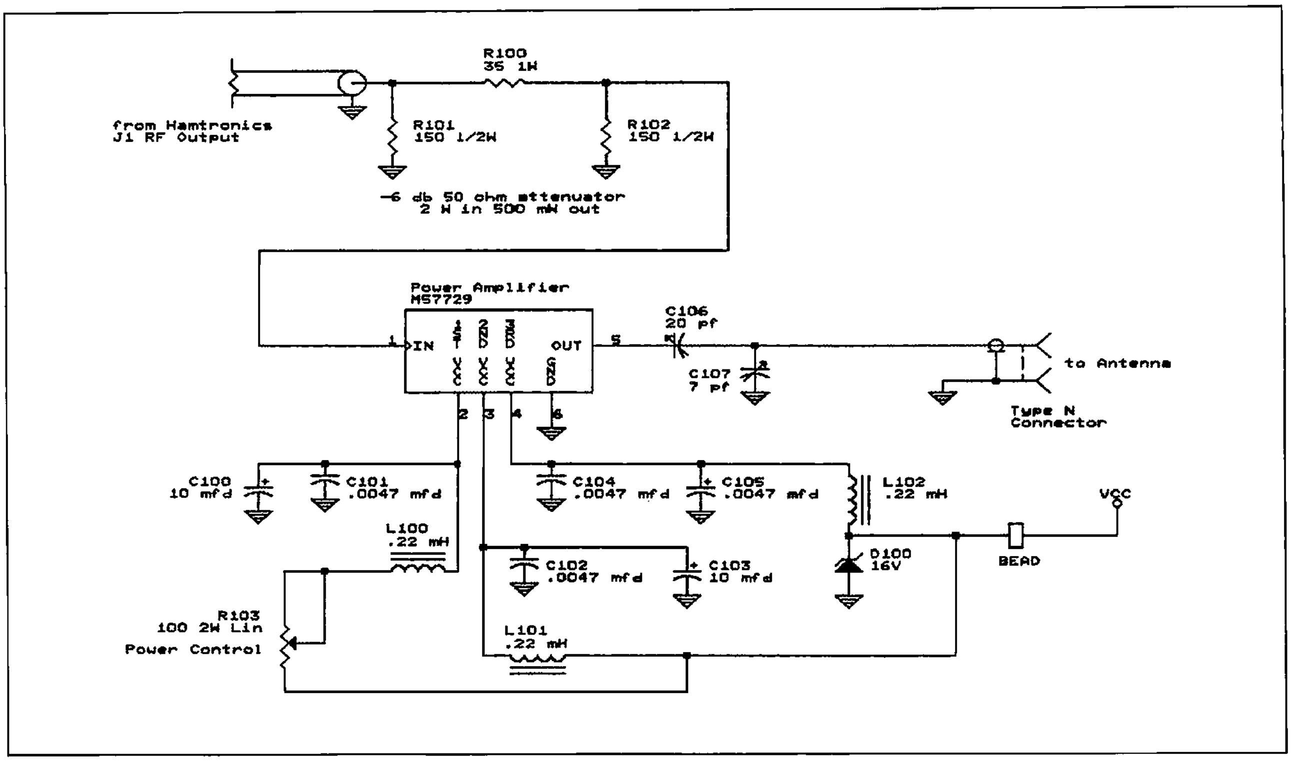


Figure 6. 430 MHz Power Amplifier.

design will initiate an interest in other beacon operators to modify existing beacons or install their own beacon for public safety. One result would be that in the near future an amateur could go anywhere on the West Coast and monitor seismic activity.

Construction

When possible, I used established kits and circuits for this beacon. Figure 1 shows the design of the system. The actual control interface has been omitted from this article as the beacon control operator could control the beacon in many different ways.

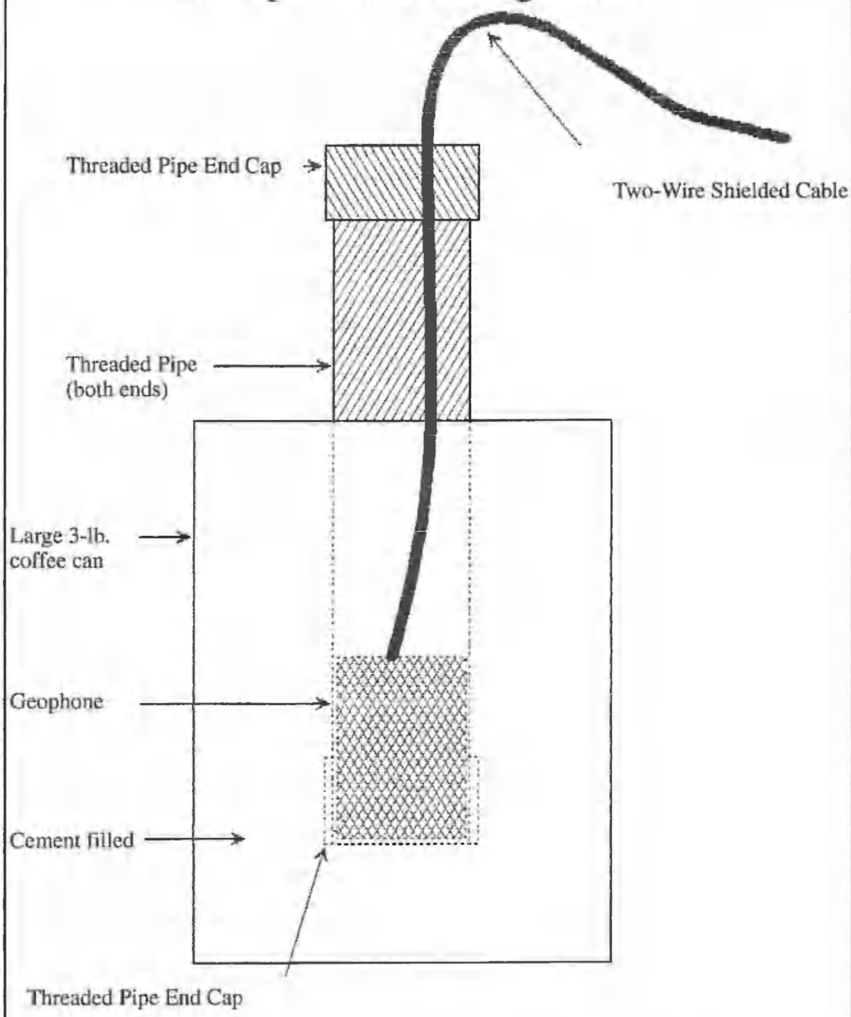
Removing the 432-MHz signal from the various power supply and signal lines can be quite a headache. Using ferrite beads, feed-through capacitors, shielded cables, and grounding methods, and experimenting with by-pass capacitors can minimize the RFI problem. There is no sure and fast method. However, the geophone amplifier, audio, ID, PL, and timing circuits (Figures 2–7) cannot be in the same RF-tight box as the transmitter or power amplifier module!

Adjustments

The various circuit adjustments are rather straightforward. Adjustments are set for the best audio quality and your seismic energy sensitivity preference. The threshold trip point is set for the PL tone activation. The time delay adjust is to help eliminate false tripping of the PL tone activation.

Hamtronics transmitters can run continuously at 2 watts of power but still get quite warm, so I recommend a small cooling fan. To eliminate this fan requirement, I run the Hamtronics transmitter at about 1 watt. The nearly 1-watt signal is further attenuated and used as an exciter into a S-AU4 PA brick. The power on the PA board is capable of 15 watts, but is set to run at a cool 10 watts. The power amplifier is an optional item, which is a matter of personal preference. ■

Geophone Mounting Fixture



The total weight of the fixture is about 16 lbs. A small piece of foam rubber is placed in the bottom of the pipe. A wooden dowel is carefully measured and placed on top of the geophone to the top of the pipe end. The geophone is now firmly held in place. Silicon caulking is placed at the wire exit to make a moisture-tight fixture.

(copyright) 1991 Kuby Kommunications, Rowland Hts., CA

Figure 7. Geophone Mounting Fixture.

N6JSX Seismic Beacon—Purchased Equipment List

Hamtronics TA451 UHF Transmitter 12-VDC Kit	$99.00	(716) 392-9430
Crystal 432.350 MHz	$12.00	
Crystal Oven	$30.00	
A16 RF Tight Box	$30.00	
Autocode ATS IDer 12-VDC Programmed N6JSX/B	$79.50	(805) 497-4620
Communications Specialists SS-32 12VDC	$29.95	(714) 998-3021
Oyo Geospace GS-11D-1C 4.5-Hz vert. geophone	$56.00	(713) 939-9700
RF Parts Co. S-AU4 Power Amp 12VDC	$75.00	(619) 744-0728
Unicorn Electronics—various ICs & diodes		(818) 341-8833
XR-2206 Mono Function Gen	$3.79	
4538 Prec Mono Multivib	$0.69	
LM-324 Quad Op-Amp	$0.33	
Norcon Engineering TD16 Controller 12-VDC Kit	$44.95	(706) 664-7817

Senior Citizens Upgrade

by Hal (Doc) Goodman W3UWH

On October 29, 1948, I received my ham license. A few years later I was able to earn my General Class license. It was not until November 1994 that I finally upgraded to Advanced Class and January 1995 that I earned my Extra Class ticket. It took two tries to pass the code. The first time the arthritis in my hands slowed me down too much.

Much to my surprise, my new Extra Class license arrived by mail within a week. Not only did I receive the usual wallet-sized license, but I also received a beautiful 5 by 7 inch copy suitable for framing.

I immediately got on the phone to ARRL and made arrangements to get my volunteer examiner's credentials. Having studied the manual and answered all the questions, I mailed the packet back to the ARRL. They never told me, but I think I got all the questions right. Several weeks later, I received by mail my shiny new badge with its impressive red lettering identifying me as an Extra Class volunteer examiner.

Since that time I have had the privilege of taking part, with a large group of volunteer examiners, in several testing sessions. And it is a privilege to be able to share in the joy when someone gets his or her first license or, after much effort, is finally able to upgrade. At one session, while waiting for the testing to begin, I was able to help a newly minted Tech-plus make his first CW contact using the club station. I sat next to him and copied the incoming code with him so he could relax and not worry about missing anything. I helped him figure out what to reply with and when he should repeat things, such as RST and name. When it was all over, I felt like an old pro and he felt like he was finally a real ham.

At the last testing session I participated in the testing of a 13-year-old boy who blew the lid off the exam. He got 100% on his code test and 100% on his written exam. This was not a Novice exam. He blew the lid off the Extra Class exam!

In talking with other old hands like myself who have reached retirement age and now have time to appreciate ham radio, I kept urging them to upgrade. I informed them of all the fun they could have as a volunteer examiner. I told them how good it felt, when working the Maritime Net, to be able to go down to 150 and find an open spot to run a phone patch without all the usual interference. The more I talked, the more they all seemed just to get quiet and lose interest in the conversation. When I questioned them about why they weren't interested, their answers surprised me.

"So, not being willing to let well enough alone or, in this case, badly enough alone, I pressed them about this 'crazy' idea of getting an automatic upgrade."

They believe that after thirty, forty, fifty, or more years as hams who have done things right and have no violations, they ought automatically to be given an upgrade. Now you should understand that these are hams who got Class "B" licenses or, in a few cases, General Class licenses before half the current hams were born. They, for the most part, have lived very successful lives both personally and professionally. They were not the type of people who had lost interest in life or their hobby.

So, not being willing to let well enough alone or, in this case, badly enough alone, I pressed them about this "crazy" idea of getting an automatic upgrade. What they finally admitted was that they could not do the high-level math and did not feel they were still able to memorize well enough to pass either the Advanced or Extra exam. They felt they could handle a 20-wpm code test, but almost nothing could convince them that it was even worth trying the written. They were absolutely convinced that at their age they had no chance of passing. What is even more ironic is that most of these guys had forgotten more radio and electronic theory than I will ever know.

I explained to a couple of my close friends that I could show them how they could pass without having to learn the "new math." I told them that if they agreed, I would spend only 10 minutes a day with them for a few weeks and guarantee that they would get all the math questions right without having to do any math. One friend finally said okay, and I gave him my copy of the Advanced Class license preparation manual. However, every time I stopped by to visit him there was always something that needed doing—anything but work on the test.

This is a shame. Here they were, the very people who built ham radio, at a time in their lives when ham radio was their main method for socializing and keeping active, and they did not have all the privileges and opportunities that an upgrade could give them.

Simply to give an automatic upgrade is unfair. So what I would like to propose is a senior citizens upgrade exam. To qualify, a ham would have to be at least 60 years old and have been licensed (General Class) for at least 25 years. The exam would consist of ques-

tions on radio etiquette, rules and regulations, basic radio theory (not nands and nors and polar coordinates), contributions of ham radio to public safety and well being, the history of ham radio, and so forth.

I am not suggesting that the test be so superficial and easy that it doesn't require any study. It should be reasonably difficult enough that it allows the seniors to feel as if they really earned the upgrade, such as through drawing schematics and designing circuits. The exam could be challenging without asking them to do high-level math.

I was talking to a Norwegian station a little while ago. He told me that in order for him to get his Extra Class license, which incidentally has more privileges than an American Extra Class, he had to pass a 12-wpm code test and a written exam that is the equivalent of our General Class exam.

This may sound like sour grapes; however, if the rest of the world is willing to give their hams a break, we could at least be more understanding of our own old-timers. Experience, etiquette, patience, understanding, and wisdom generally come with age. New math, however, is for youngsters. You will never be able to convince these "old dogs" that they can learn new math.

What is needed is for us to start a campaign to benefit our senior hams. We should be exploring ways to cooperate with the FCC in designing a Senior Citizens Advanced Grade test. And if that works out, even an Extra Class exam that still requires 20-wpm code but does not require learning new math.

As a VE, I am involved in administering and scoring all levels of written tests as well as all levels of code proficiency. It would not be any burden to add one or two additional written tests. I am sure that my fellow VEs share my feeling. The sheer pleasure of seeing some old-timer upgrade is no less than watching a youngster getting his first license.

The purpose of our hobby is not just enjoyment. We are here to perform public service in times of need. Who better to reward than those who have for years faithfully performed public services and helped ham radio gain its good reputation?

I would like my fellow hams to start a dialogue. Write in, fax, get on the air, and discuss the idea of a senior citizen upgrade. If I am wrong and most hams don't favor the idea, so be it. If I am right, then let's get the ball rolling while many of our senior hams are still around to take advantage of the upgrade.

Number 11 on your Feedback card

QRP Mini-Tuner

A neat little addition to your rig.

by Mark L. Meyer

Have you ever wished for a physically small antenna tuner for your portable operations or maybe to build into your next rig? Here is one that will fit the bill.

There is nothing new about the circuit. This is the old familiar "T" match circuit that has been around for years. The feature that will catch your attention is that this design uses toroids for the inductors. Inductors wound on toroidal cores concentrate the field within the core. They also pack plenty of inductance into a small package. This allows you to compact the design without loss of performance.

All the parts are easily obtained. The toroid cores are the garden variety available from Palomar, Amidon, Dan's Small Parts, Ocean State, and many others. The switches specified are light-duty Radio Shack units.

The variable capacitors are the APC type that can be panel mounted with the rotor and stator both insulated above ground. Almost any variable will work as long as you remember that however you construct your unit, neither rotor nor stator can be grounded. You don't have to worry about the plate spacing if you operate at QRP levels. Many of these can be found in the junk box and hamfests, or you can order them from Dan's Small Parts. APC types do require an insulated knob to protect you from getting "bit" by RF.

In Figure 1, the diagram specifies 150 pF for the variable capacitors C1 and C2, but any value from 150 to 250 pF is suitable. I had the 150 pF units, so I used them. On the output side, I paralleled a variable C2 with a 36 pF capacitor to increase the loading slightly. This will not be necessary if you use a 200–250 pF unit.

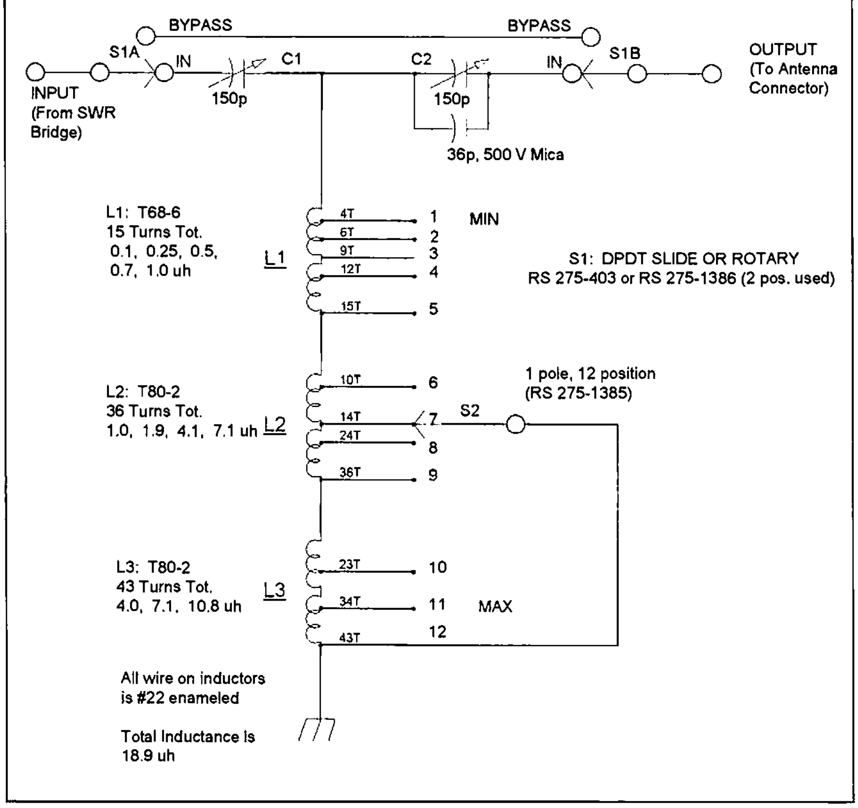


Figure 1. QRP Antenna Tuner.

When winding the toroids, space the winding out over about 3/4 of the core. When you come to a tap turn, twist a small loop in the wire and then keep on winding. When you have the entire winding on, you can use some Duco cement, Q-dope, or epoxy to help keep the winding in place. Scrape the insulation off the end wires and off the loops you place for taps and you're ready to hook things up.

If you use fairly stiff wires to connect to the taps, and if you allow room, you can mount the toroids hanging in air off the switch taps. Thin strips of copper or solder-saturated solder wick can be used as wide, flat conductors to connect to the capacitors and connectors to keep stray inductance down for better high-frequency performance.

With a "T" match, more than one setting of the controls can be found that will minimize the SWR. The correct setting to use is the one that maximizes the C2's capacitance. This will insure the most efficient operation. To tune up, select a tap setting, set C1 and C2 to mid-range, and then peak a received signal. Then apply low power, and tune C1 and C2 for minimum SWR indication. Try to find a tap number that will result in the maximum C2 capacitance. Experiment.

I have my unit built into a home-brew 20-40-80 meter transceiver. With most antennas I find that I generally have the inductor tap set at 3 for 20 meter operation, 6 for 40 meters, and 8 for 80 meters.

With this antenna tuner you can use any of the SWR-indicating meters designed for low power. I find the one designed by G4ZNQ to be about the best. This bridge circuit can be found in Doug DeMaw's *W1FB's Design Notebook.*

This little tuner will be a great addition to your QRP arsenal.

Number 12 on your Feedback card

by Peter H. Putman KT2B

The Ramsey Electronics SX-20 QRP SSB/CW 20m Transceiver

Ramsey Electronics
793 Canning Parkway
Victor, NY 14564-8924
Price class: $349.95 (kit)
$429.95 (wired and tested)

A QRP powerhouse.

Yes, that's right . . . *another* QRP rig for 20 meters. Boy, it's getting harder to flip through *73* these days without coming across an advertisement or review for transceivers like these. Build-it-yourself QRP rigs for 20 m, 40 m, and other bands are about as hot as pogs, O. J. Simpson, and sport utility vehicles! But the SX-20 isn't really "just another QRP rig," what with features like direct digital synthesis (DDS), dual VFOs, RIT, built-in iambic keyer, three different tuning speeds, WWV coverage, and a pretty versatile CW filter. And it's all yours for about $350 and a couple of weekends of your time.

When I first saw the SX-20 at Dayton '94, I was impressed with its compact size, one-piece board construction, and range of features. It was only a matter of time before I persuaded John Ramsey to send one down for a build-up and evaluation. And my timing was perfect: While SX-20s had previously been shipped, wired, and tested, the kit versions were just being released, meaning I'd have a chance to debug the manual during construction.

Specifications

The design behind the SX-20 is pretty clever, packing a lot of features into a 9.5"W x 3.7"H x 9"D case weighing all of 5 pounds (see Figure 1). It makes extensive use of LSI chips for all active signal processing, and tuning adjustments are kept to a minimum. Frequency coverage is from 14.0 to 14.5 MHz on receive and 14.0 to 14.35 MHz on transmit, using either 10-Hz, 100-Hz, or 1-kHz steps.

The output stage uses a pair of P3055E power MOSFETs, and maximum power output is spec'ed at 10 watts, though you can adjust this down to under 1 watt using the ALC control for true-blue QRP operation. Receiver sensitivity is claimed to be less than .25 µV for 10 dB S/N, and selectivity in standard SSB mode is -6 dB > 2.3 kHz and -60 dB < 4.0 kHz. But enough numbers! Let's take a look inside the SX-20 and see what makes it tick.

How It Works

The heart of the SX-20 is a Harris HSP45102 chip, working as a direct digital synthesizer. DDS circuits have become quite popular in contemporary transceiver designs, owing to a combination of reasonable cost, compact size, and accuracy. It outputs LO frequencies between 7.5 and 8.5 MHz, which are mixed with the incoming 20 meter signals in an NE602A mixer chip to the first IF of 6.143 MHz. Additional filtering is provided by a six-pole, 2.5-kHz crystal filter before the signal is sent to a CA1350P IF amplifier. Another NE602A mixer works with the second LO at 6.1415 MHz and a CW/SSB frequency offset circuit to provide signals for the LM324 audio amplifier.

In transmit mode, incoming audio signals are amplified a couple of times and fed to a MC1496 balanced modulator/mixer circuit. The suppressed carrier 6.1415 MHz signal from this chip is then sent through the same six-pole crystal filter from before and into an NE602 mixer, which combines this signal with the same 7.5- to 8.5-MHz DDS frequencies to produce the final 20 meter signal. Additional bandpass filtering cleans up the RF before it gets to the 2N3866 pre-driver, P3055E driver, and the final output stage.

The "brains" of the circuit (as Ramsey likes to call it) is a member of the popular Motorola 68HC05-series microcontroller family Working with a handful of other components, including an inverter and shift register, this processor controls front panel displays, interprets switch closures from the front panel membrane keyboard, and selects the various TX/RX, filter, and mode states.

While there are quite a few bipolar transistors scattered throughout the circuit, they're all either 228256 PNP or 2N3904 NPN devices that perform very simple functions—in fact, most of the time they're just working as switches or low-level amplifiers. This is one of the reasons there are so few circuits to tune in the SX-20, and why the kit is so reasonably priced—none of the components used is that exotic and costly. Even the 68HC05 micro is available in abundant quantities and iterations.

Human interfaces to the SX-20 (let's not forget those!) include a main tuning control, microphone gain control, volume control, a standard eight-pin microphone connector that works with Ramsey's mikes or any ICOM mi-

crophone, and membrane-button controls for TUNING SPEED, DIAL LOCK, RIT, MODE, KEYER, ATTENUATOR, AGC FAST/SLOW, VFO A/B, and WWV. The display is made up of eight-segment, red, alphanumeric LEDs (you were expecting LCDs?) that read to 10-Hz resolution; an eight-step LED S-meter and headphone jack round out the front panel.

Rear-panel connections are kept to a minimum: a standard SO-239 UHF jack for the antenna, stereo phone jack for your CW key, and a 2.5 mm power jack for connection to 12–14 volts. I should add that I'm not thrilled with the use of that particular power plug, as they slide out of the jacks quite easily. My suggestion would be to go to a Molex or other locking connector.

Other controls are provided for calibrating the S-meter, setting the sidetone level when transmitting CW, setting the CW TX/RX cycle delay, and controlling power output. But you'll need to remove the cover to adjust them. Considering that CW delay and sidetone levels are often adjusted to suit the operating circumstances, I think it would be smart of Ramsey to relocate these controls and provide access to them either through the side or top of the transceiver.

Putting It Together

Ramsey has always done a first-rate job of packaging up their kits, and the SX-20 is no exception. There are eight different sub-assemblies to put together, and individual bags with all the parts for each are clearly identified. Good thing, too, as there are nearly 600 individual components in the kit (not including the optional CW filter)! But mistakes can happen; my particular kit was missing the microcontroller and DDS chips, which were promptly shipped via express mail after a call to Rochester.

If you read the manual carefully, you should have little difficulty in getting each stage of the SX-20 up and running. Each section opens with a discussion of the theory and operation of that circuit, followed by a detailed parts list and parts overlay. Three schematics and two large overlays are also provided with views of the main board and front panel, so locating parts is a quick job.

In addition, both the front panel and main PC boards have part numbers and locations screened right on them; thus, if you install something backwards, blame that guy in the mirror! (**Hint:** When first setting up my work area, I usually spread out sheets of white paper to sort the various parts on. It is considerably easier to spot small capacitors, diodes, and resistors this way.)

The SX-20 instruction manual contains the usual detailed instructions, check-your-work boxes, and off-the-wall Ramsey wit. (The jokes and puns are especially effective during a 3 am building session.) At the end of each chapter, you solder up a few wires, apply power, and check to see if that particular circuit is functional. If not, some troubleshooting hints are provided so you can back up and recheck your work.

Fun and Games

Probably the trickiest part of the project is the front panel assembly, which uses 21 different LEDs for indicators. Because the front panel itself is a membrane keyboard, you must take care must when soldering in the LEDs to avoid pressing too hard against the panel and damaging it. What you actually do is insert all the LEDs in their holes, attach the panel, and tilt everything upside down. The LEDs will just touch the membrane and you can finish soldering and trimming leads. (Of course, I managed to put one LED in backwards!)

Another tricky job involves winding the various transformers between the predriver and driver stages, driver and finals, and final output. These are turns of #24 enamel on large ferrite cores which have been pre-drilled. While winding the turns isn't hard in itself, there have been problems with sharp edges on the core holes that have actually nicked the wire. Since the cores are made of a conductive material, it's possible that the 13.8 volt supply could be shorted, or that turns could be shorted to themselves. (This happened to me.) Tom Hodge of Ramsey advised me that they are now checking these cores under magnifying glasses to make sure they're deburred.

More fun stuff: While testing the front panel, I inadvertently installed one of the Relliflex cables into the wrong side of the connector. After talking to the folks at Ramsey and realizing my error, I inserted it the correct way—and nothing happened! When I first installed the cable incorrectly, it "dimpled" the silver fingers enough so they wouldn't make contact. Rubbing them gently with a pencil eraser cured the problem.

Here's another change for the better: During testing of each stage of the SX-20, the manual requires you to solder up volume control, power, and speaker wires, then desolder them so you can proceed with the next assembly and be able to flip the board over and back. Current kit versions now use molex connectors to eliminate these steps and relieve wire stress.

While these may sound like an annoying series of minor problems, I can assure you they are quite common when debugging a kit and in every case were easily fixed (especially problems caused by my careless assembly!); nor did they slow me down much, as I was still able to test all of the stages of the rig to make sure things were working. When I hit a real stumper, Tom Hodge was able to come up with a good answer in short order.

By now, you may be wondering how long it will take to assemble an SX-20. I like to build at odd hours and work pretty quickly, but my conservative guess is probably four or five nights, with plenty of breaks to check your work and stretch. And you don't need much in the way of tools, either; a 25W to 40W soldering iron, diagonal cutters, small pliers, and wire strippers will suffice for board assembly. A magnifying worklamp is a real help.

Alignment

Tuning up the SX-20 is a fairly quick procedure, and using some rudimentary test equipment makes it go a lot faster. The receiver can be aligned with a strong on-air signal, but I used my time-tested HP608F signal generator, since it isn't affected by sunspots! Ramsey provides their universal "diddle stick" plastic alignment tool, which is used to peak up about nine different transformers for maximum signal. The calibrated generator also makes it easier to set the S-meter correctly, but you could also do this by comparing signals to a calibrated reading on another rig.

On transmit, a frequency counter is a must to set the local oscillators to 6.143 and 6.1415 MHz. I suggest letting the radio warm up and sit for about 15 minutes before making this adjustment. You'll need a VOM or FETVOM to set the idling current for the driver and finals, and this setting will change slightly as the FETs warm up. Make sure you hook up a good 50-ohm dummy load (or antenna, if you haven't anything else to use) during this step. If you have access to an accurate wattmeter, you can set the power output down as low as 1 watt and as high as 12 watts by adjusting the ALC control.

When you first turn on the SX-20, it signals "7" in CW and the numbers "7" and "3" march

Specifications

RAMSEY ELECTRONICS SX-20 20 METER TRANSCEIVER:

Price:	\$349.95 in kit form \$429.95 wired and tested
Frequency Coverage:	Receive 14.0—14.5 MHz in 10-Hz steps WWV @ 15.000 MHz Transmit 14.0—14.35 MHz in 10-Hz steps
Power Requirements:	13.8 VDC (11.8 to 15.8 VDC) Transmit: 5.0 A Receive: 500 mA
Output Power:	10 Watts PEP
Spurious Emissions:	> 50 dB below peak power
Sensitivity:	< 0.25 μV for 10 dB S/N
Selectivity:	-6 dB > 2.3 kHz -60 dB < 4.0 kHz
Spurious Rejection:	> 70 dB
Audio Output Power:	>2.6 W @ 10% distortion across 8 ohms
Dimensions:	9.5" (W) x 3.7" (H) x 9.0" (D)
Weight:	5 lbs.

along the screen; this is part of the boot-up test on the microcontroller. The display will then turn to 14.225.00 MHz (14.125.00 MHz on VFO B) and you'll be in business. Ramsey sent along the optional CW switched-capacitor filter kit, which comes from the factory set at 700 Hz bandwidth. I switched it to 500 Hz by resoldering a few jumpers, plugged it in, and got on the air in short order.

On the Air

The SX-20 compared favorably to my IC-751A in just about every instance, except when signals stronger than about S7 were received. In this case, the audio quality seemed a bit harsh, as if the waveform was flat-topping a bit, and this applied regardless of whether the AGC was set to fast or slow. Sensitivity measurements for 10 dB S/N are pretty much as claimed, and I measured S1 with 4 µV of signal applied at 14.225 MHz. The 500-Hz CW filter works as well as my IC-751A, with very little ringing.

In transmit mode, I had some trouble getting much output with my standard ICOM mobile microphone. Switching to an SM-8 mike and cranking the gain up almost all the way produced better results, but it took some reworking of the preamplifier stages, as mentioned earlier. I also substituted the stock Ramsey hand-held mike and got the same results, so you'll probably want to run the MIC GAIN control about 75% open.

The CW keyer speed is set by plugging in an iambic paddle, pushing the KEYER SPEED button, and sending dashes or dots while rotating the main tuning knob. Keyer speed can be set from 0 wpm (basically carrier on) to 30 wpm, but I should point out the key is also active in SSB mode. Tapping it won't send CW but will switch the rig into transmit mode; so watch those elbows!

Received signal reports were good in SSB mode, comparable to my ICOM setup with a hand-held microphone. On CW, the keying is very smooth, although it sounded not entirely free of clicks. I'd like to see the folks at Ramsey get rid of the T/R relay and use PIN diodes for switching, thereby allowing full break-in operation. You'll also want to tweak the CW sidetone a few times, since I found that a good setting for the internal speaker was too loud with headphones. Ramsey is now shipping a slightly larger tuning knob with a finger recess, which makes rapid frequency excursions easier.

Conclusions

The SX-20 is definitely not for the first-time kit builder, but if you've logged a few hours on your soldering iron and are used to "stuffing boards," it's a fun kit to put together and you'll be very pleased with the performance of the radio for the price. Its size lends itself well to suitcase or backpack operation, and there's any number of small antenna designs that work nicely with it. By the way, for you 40 meter enthusiasts, Ramsey is now considering brewing up an SX-40. Perhaps we'll get lucky and also see versions for 15 and 10 meters! ■

73 Review

Number 13 on your Feedback card

by Peter J. Bertini K1ZJH

Maggiore Electronic Lab
600 Westtown Road
West Chester, PA 19382
voice: (610) 436-6051
fax:(610) 436-6268
Price classes $589.00 to $1305.00

The Maggiore Hi Pro R1 Repeater

A full-featured repeater at an affordable price.

In celebration of their 25th Anniversary, Maggiore Electronics unveiled the new R1 repeater at the 1995 Dayton HamVention. This review is based on the unit I received for evaluation, a R1 2 meter VHF repeater outfitted with the optional Computer Automation Technologies 300DX controller, and 35-watt transmitter.

This particular configuration is Maggiore's model R1VHF35DX and lists for $1,245.00 for either the 35-watt 144-MHz or 25-watt 222-MHz repeater. The 20-watt UHF repeater with the CAT300DX is $1,305.00. If you already own a controller, the R1 pricing starts as low as $589.00 for a 2 meter 5-watt package. Maggiore also offers R1 repeaters with a basic COR, ID, and timer board starting at $650.00. Repeater rack cabinets, duplexers, premade cables, power supplies, and high-power repeater amplifiers are also offered at discounted amateur net pricing. I suggest you write or call Maggiore Electronics for a catalog or to discuss finding the R1 repeater system that meets your exact needs. The R1 is FCC type-accepted for commercial service.

The R1 repeater is enclosed in a sturdy 3.5" high by 9" deep steel custom cabinet intended for mounting in a standard 19" rack cabinet (see Photo A). The cabinet has a rugged black epoxy finish with contrasting white lettering. The R1 repeater weighs only 9 pounds. Imagine your club's three 144-, 222-, and 440-MHz repeaters stacked together in less than 12 inches of vertical rack space! (Some space should be left between R1 repeaters for air circulation if they are stacked.) All controls are internal and, once set, need no further adjustment.

Peeking Inside

The steel enclosure is divided into three RF-tight compartments (see Photo B) with the top cover being an integral part of the shielding. Fifteen screws secure the top cover to the R1 repeater enclosure. The liberal use of RF feedthrough capacitors help to maintain the isolation between the computer controller, receiver, and transmitter compartments.

Despite its small size you can see from the photos that the inside of the R1 is still "roomy," with ample space for CTCSS boards, audio delay boards, or other accessories. The R1 requires 13.8 VDC at 5 amps to produce 35 watts, making it an attractive candidate for use with alternative power sources.

"Despite its small size you can see from the photos that the inside of the R1 is still 'roomy,' with ample space for CTCSS boards, audio delay boards, or other accessories."

Maggiore EV1 transmitter

The EV1 exciter is a real workhorse. The power output is 5 watts on 2 meters, but this can be reduced by a driver stage trimpot setting. Maggiore has been using the EV1 exciter for the past several years, and this current version reflects all of the improvements made to the design. Substantial changes have been done to the audio and phase modulator stages, making it so the R1 has excellent audio. The modulator has an input for CTCSS tone encoding.

The oscillator is temperature compensated and holds its frequency to within a few hundred cycles. The 35-watt PA (model PAV-1) mounts on the rear chassis apron and uses a Motorola MRF 240 transistor. The repeater is rated for operation over a range of -20 to 60 degrees C. For hotter climates a R1F fan kit is available. This fan is PTT keyed and uses an additional 150 mA in the transmit mode. The repeater is rated for continuous commercial service. Also, the black finish on the steel case is a good heat emitter, which helps to dissipate the excess heat.

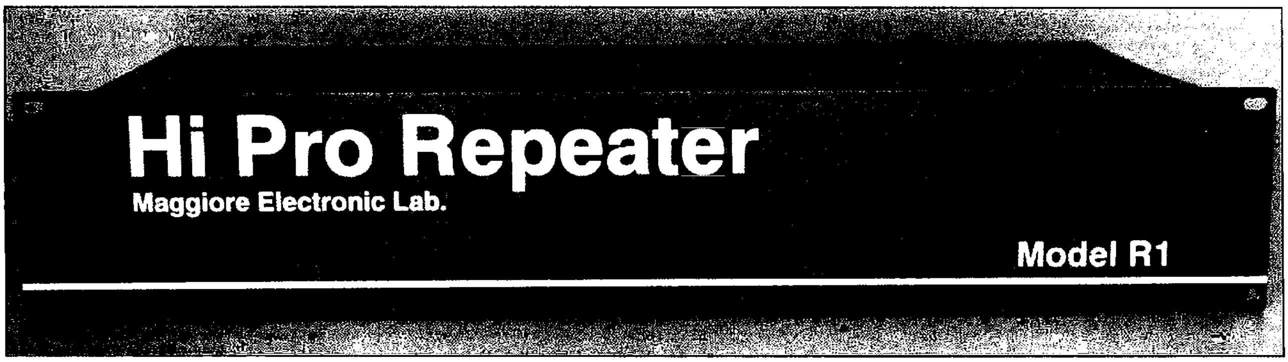


Photo A. The Maggiore Hi Pro Repeater.

The Maggiore R4V receiver

Like the transmitter, the R4V VHF receiver is a proven design. All coils are shielded (unlike some competitive offerings), resulting in minimal unwanted interstage coupling and out-of-band responses. This receiver design is totally stable. Five lightly coupled tuned stages at the operating frequency protect the RF and mixer stages from strong adjacent commercial transmitters. The first IF is at 10.7 MHz. Eight poles of crystal filtering follow the mixer, putting the selectivity up front, where it belongs. The second IF operates at 455 kHz. The second LO may operate at either 10.245 or 11.155 MHz to resolve "birdie" problems at certain frequencies. Repeater sites bothered by strong 15-kHz adjacent channel users may benefit by using the optional Murata "E" 455-kHz, 14-pole ceramic filter for greater IF skirt selectivity. An even sharper "F" filter is offered, but DTMF decoding may be adversely affected if this narrow bandwidth filter is used.

Trimpots are mounted on the R4V board for the volume and squelch settings. The squelch threshold is a bit tricky to set; but once you find the optimum point, it is extremely stable and will require no further adjustment, even over wide variations in supply voltage or temperature—a boon when operating from gel cell batteries with varying degrees of charge.

An open collector output is available for the COR signal. This open collector may be configured for low or high activity to meet the requirements of the controller used. Repeater audio for the controller may be taken from the discriminator directly (no audio pre-emphasis) from the high side of the volume control pot (audio pre-emphasis compensated) or from the 8-ohm speaker output (audio pre-emphasis compensated and squelch muted). Since the CAT controllers employ audio switches that follow the COR/COR-CTCSS signals, raw receiver audio may be fed directly to the controller from any point after the discriminator. A CTCSS decoder can directly mute the R4V receiver squelch line, or key a controller with a CTCSS input.

Controllers

As mentioned earlier, you may order the R1 without a controller. Maggiore offers an economical Hi Pro COR1 board which will supply a CW ID and basic repeater timer functions. If your club is on a tight budget and doesn't need a patch or other frills, it is perhaps a good choice. If you want some bells and whistles, such as a full-featured autopatch, voice synthesizer for announcements and IDs, and other niceties, I recommend you consider ordering either the CAT-300 or CAT-300DX controller with your R1. For the past few years we have been using Computer Automation Technologies CAT-1000 controllers (sort of a "bigger brother" to the CAT-300) on our three 2 meter Maggiore Hi Pro repeaters. I was extremely pleased to see Maggiore Electronics integrate this product line into their repeaters! (For those who demand the ultimate in controllers, a matching enclosure will be forthcoming to house the CAT-1000 for use with the R1.)

The CAT-300DX

The CAT-300 repeater controller has a 412-word vocabulary for amateur repeater operation. This allows the construction of voice messages for repeater IDs or special club announcements that are stored in a 12-position voice message table. An optional 16-channel Digital Voice Recorder is also available. The CAT-300DX differs from the CAT-300 in that a Dallas time chip is added. The CAT-300 Dallas chip contains only 2K of memory; this is increased to 8K with the Dallas time chip in the DX controller. The additional memory allows adding many functions besides the time feature alone. Memory in both versions is nonvolatile, as the Dallas chips contain an internal lithium battery backup. I think that the CAT-300DX controller offers the best value. The CAT-300 may be easily upgraded to a CAT-300DX at a later date, but the cost will be higher than the advertised difference in price. Controller programming is done via DTMF entry, either on the phone line or over the air.

"Also, the black finish on the steel case is a good heat emitter, which helps to dissipate the excess heat."

The CAT-300DX has additional autopatch capacity and also a 40-position scheduler. The scheduler allows full automation of the repeater based on the internal clock and calendar.

With the CAT-300DX you also get the digital voice clock. A digital voice readback of the time may be supplied on demand, with IDs, patches, voice messages, with scheduled operations or through the grandfather clock feature. The day of the week, day of the month, and month are also available as a time variable. Another time variable is the "salutations" greeting, a friendly female voice that gives the appropriate "good evening," "good morning," or "good afternoon" salutation depending upon the time of day.

The full-featured CAT-300 autopatch allows both manual patches and quick access to up to 25 speed dial numbers (100 speed dial numbers in the DX.) First digit 0 or 1 long distance lockout protection is provided. Voice readback of the entered phone number occurs with manual patches. The patch can be run open or closed access. The CAT controllers meet FCC part 15 requirements and have a part 68 registration number.

You can save and recall up to four unique repeater configurations in the DX controller. This permits unique repeater characteristics (timers, IDs, patch availability, etc.) for special events, such as during nets or peak traffic hours on the repeater. These memory files can be recalled, modified, and/or saved manually by DTMF entry, or scheduled to occur at preset times.

The CAT300DX offers a powerful macro command programming structure, and up to 10 macros can be stored. Macros can be executed by DTMF entry, sensing a repeater user input condition, via the scheduler, or even by another macro. Macros can allow for extra long voice messages by stringing several voice messages together, combining voice messages with memory file recalls, and controlling the user output switches, and perform many other functions.

Up to eight custom courtesy tones can be programmed and saved for future use. Cour-

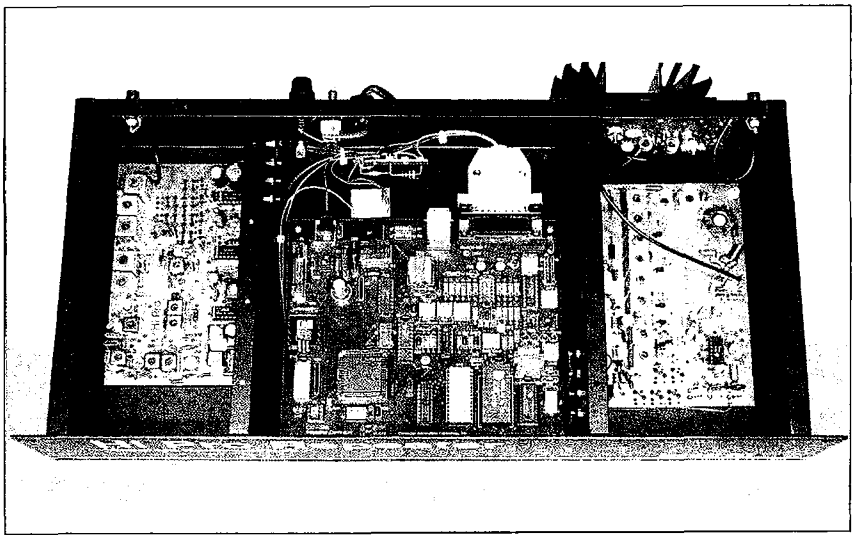


Photo B. Peeking inside the R1 repeater. The R4V receiver is in the left-hand side compartment; the EV1 exciter and 35-watt PA are mounted in the right-hand side compartment. The CAT300DX controller is in the center compartment.

tesy tones can consist of up to three different tone frequencies of various lengths and separations. IDs can be done in CW or voice.

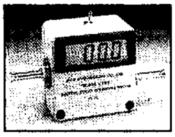
Two hardware input and three user-function output switches are available. The outputs control external devices such as power amps, etc. The inputs can be used for temperature or burglar alarm sensing, an SWR alarm, etc. For example, you could write a macro that upon detection of a high SWR would disconnect the power amp, give a digital voice announcement warning the control operators of the failure, and have the repeater switch to a memory file that requires CTCSS access and a unique courtesy tone!

The controller can operate as an "open" repeater, or CTCSS or DTMF access can be turned on. You will need to supply a CTCSS board such as the Communication Specialists model TS-32. This can be installed by Maggiore as an option. The TS-32 also allows simultaneous transmitter CTCSS encoding and receiver CTCSS decoding. You can also have the repeater run "open access" for a predetermined time interval upon detection of the proper CTCSS or DTMF sequence to allow transients access to the repeater once it is in use. Or, control operator DTMF control functions can be protected by requiring the proper CTCSS tone for their acceptance. The key-up delay timer and the inactivity "sleep" timer (and all other timers) are remotely programmable.

"I am pleased with the Maggiore R1 repeater—in appearance, quality, and performance."

Conclusion

I am pleased with the Maggiore R1 repeater—in appearance, quality, and performance. Frank has been able to offer this repeater at this low price with no sacrifice in quality due to the time he has spent in designing the enclosure. These repeaters can be constructed in a fraction of the time it takes him to assemble some of his other models. Savings represented by the lack of unneeded frills (front panel speaker, knobs, custom die cast aluminum boxes, etc.) are all passed onto the buyer. Note that the "meat-and-potatoes" of the Maggiore R1 repeater, the R4V receiver and EV1 exciter, are the same as used in the most expensive Maggiore commercial repeater systems! The marriage of the CAT series of controllers with the Maggiore repeater is also something I have long awaited. You could easily spend twice the cost of the deluxe R1VHF35DX repeater package for a competitor's controller alone! Both Maggiore and Computer Automation are good people with whom to do business, the owners being accessible for consultation or advice and having established a proven reputation for customer support and satisfaction.



Number 14 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Experimenting with the NE-602 Converter Chip

The Signetics NE-602 integrated circuit (see Figure 1) is a nifty little device that contains an oscillator stage and a Wilson Transconductance Cell Double Balanced Modulator (DBM). These features make the NE-602 a radio frequency "front-end" in a single package. Various people have used the NE-602 as a frequency converter, superheterodyne receiver front-end, product detector, and direct conversion receiver.

It will operate normally at potentials from +4.5 VDC to +8 VDC, although you can extend the operating range by using a voltage regulator (see Figure 2). Most applications seem to call for +5 to +6.8 VDC. The V+ is applied to pin No. 8, and ground is connected to pin No. 3. Both the V+ line (pin No. 8) and the V+ source are bypassed with capacitors. You can calculate the resistor value (R1) by taking the difference between the V+ source voltage and the desired operating voltage, when the current drain is about 2.6 mA (i.e., Ohm's law).

The oscillator circuit has two terminals to the outside world: One is the base of the oscillator transistor (pin No. 6), while the other is the emitter of the oscillator transistor (pin No. 7). The oscillator operates up to 200 MHz.

The heart of the NE-602 is the DBM. There are two inputs forming a balanced pair (pins 1 and 2), although in most cases the signal is applied to pin No. 1 and pin No. 2 is bypassed to ground with a 0.04 to 0.1 µF capacitor. The output is also balanced, and appears on pins 4 and 5. You can use either pin to output a signal, or they can be used as a balanced pair.

The NE-602 will provide quite good sensitivity, although the dynamic range performance suffers a bit. The NE-612 device is an upgraded NE-602, but seems a little hard to come by in the ham and hobbyist markets.

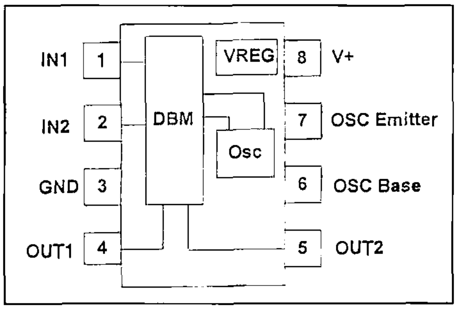


Figure1.The NE-602 internal block diagram.

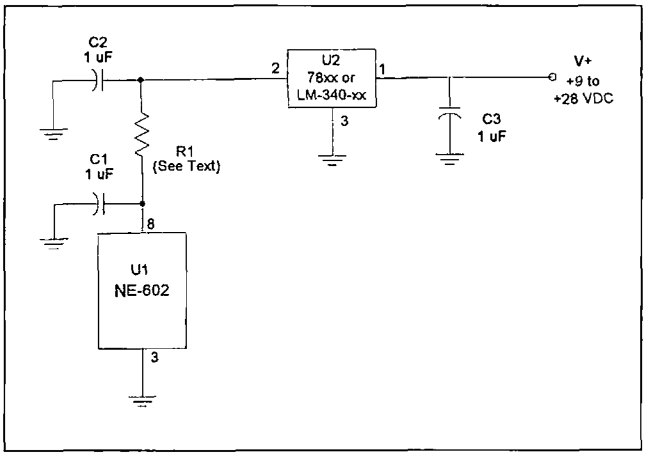


Figure 2. DC power supply for > +9 VDC applications.

NE-602 Converter Circuit

The front end of the radio receiver consists of the RF amplifier (if used) and the converter or mixer/LO stages. The basis for our designs will be the Signetics NE-602 balanced mixer integrated circuit (IC). Although this device has limited dynamic range, it is sufficient for our purposes because it compensates with a better than average noise figure and sufficient conversion gain so that an RF amplifier is not needed in most projects.

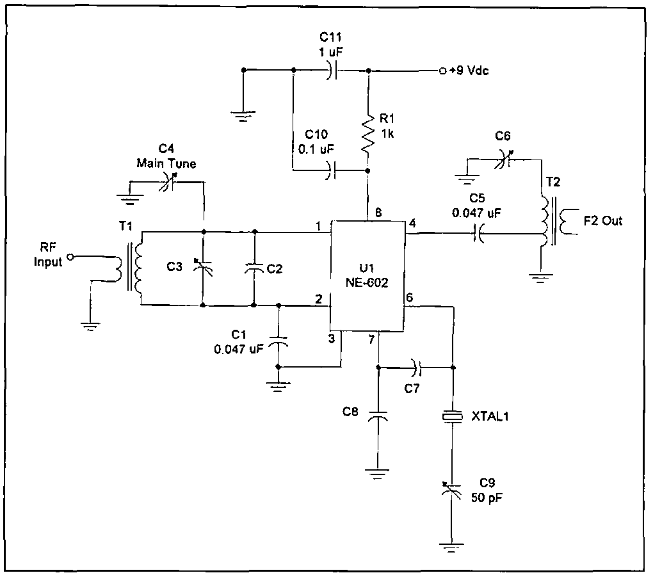


Figure 3. NE-602 frequency converter.

Figure 3 shows a simple frequency converter circuit based on the NE-602 IC. It can also be used as the front-end of a superheterodyne receiver, with the output (F2) being the desired IF frequency. The output impedances of the NE-602 are compatible with most crystal and mechanical filters used for IF selectivity.

The input side of the circuit shown in Figure 3 uses a tuned circuit consisting of the secondary winding of T1, and is resonated by the parallel combination of C2, C3, and C4. The tuned circuit must resonate at the desired RF frequency using an inductor that is not loaded too much when shunted by the 1,500 ohm input resistance of the DBM.

You can broadband the input circuit by using an RF transformer built on a toroid powdered iron form, rather than the tuned circuit. The ratio L2/L1 is typically 10:1 to 12:1; that is, there are also 10 to 12 turns on L2 for every turn on L1. Experiments and published data indicate that good starting numbers are 20 to 24 turns on L2, with 2 to 3 turns on L1 for frequencies in the upper shortwave region. As frequency is decreased, the number of turns is increased to about 34 to 40 turns on L2 at the AM broadcast band.

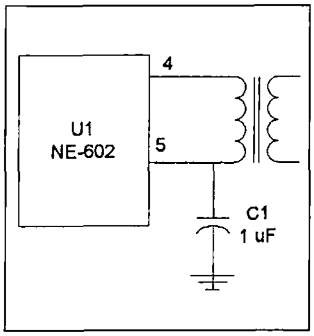


Fig. 4.Direct conversion output circuit for NE-602.

The capacitors and the 100-ohm resistor in the V+ circuit (connected to pin 8 of the NE-602) are used for isolation and decoupling. These components prevent RF in the NE-602 circuit from traveling to other stages in the radio via the DC power line or, alternatively, prevent signals from other stages from modulating the converter stage (or possibly causing oscillations).

The oscillator circuit in Figure 3 consists of the components attached to pins 6 and 7 of the NE-602 IC. In this case, a crystal oscillator is used, although a variable frequency oscillator could also be used. The operating frequency of the local oscillator section is set by the resonant frequency of crystal XTAL1. This frequency should be the RF frequency plus or minus the desired F2 output frequency, or

$$F_{XTAL} = F_{RF} \pm F2 \qquad (1)$$

The capacitor values used for the crystal oscillator are:

Continued on page 59

Number 15 on your Feedback card

ASK KABOOM

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Spectral Thinking

Last time, we were discussing the difference between the time and frequency domains. As we explored, the time domain is the familiar one we experience day to day: Things change over a period of time. In the frequency domain, though, things that change over time also change their rate of change! Let's continue:

Seeing Is Believing

We were examining the spectrum analyzer, one of the most useful, and least available, instruments to the RF experimenter. They're not generally available because they cost too much, although that's slowly starting to change for the better. Why are the darned things so expensive? Well, a spectrum analyzer is much more complex than an oscilloscope, which is already not such a cheap beast. In fact, the analyzer is a combination of a scope, a swept filter, and the necessary controls and sweep circuits to tie them together. Also, in order to capture a signal's harmonics, the analyzer has to have at least three times the upper frequency limit of the signal you're trying to examine. So, to be usable on our 144 MHz, 2 meter band, you need at least 700 MHz of response, preferably more. That kind of stuff doesn't come cheap!

Commercial spectrum analyzers typically cost $1500 and up, often way into the thousands of dollars. If you've already got a scope, it may seem like needless duplication to buy another instrument that is also based upon a scope. Yes, you can buy an adapter for your scope, and it will cost much less, thanks to the fact that it need not include its own scope circuits and CRT. Still, a decent analyzer is not a cheap thing, even if you go that route. Should you own one? Sure, if you build transmitters and can afford the cost. Do you really need one? Usually, you can get by without it, but an analyzer can be invaluable in tuning RF output stages and setting up repeaters, not to mention sniffing out stubborn intermod and other interference cases. Whether you can afford one or not (I can't!), it still pays to understand how to use one; you never know when you might be called upon to operate somebody else's unit. Besides, the more you know . . . well, the more you know, right?

Getting Started

As with an oscilloscope, setting up a spectrum analyzer is much easier if you have some idea of what you're trying to see in the first place. I suppose that's true of any measuring instrument; even an autoranging DMM needs to be set for AC, DC, or ohms, right? With the analyzer, you need to set a frequency span that corresponds to what you're looking for. A "center frequency" control does just what it sounds like: It sets the center of the span wherever you want it. That may be the same frequency as your input signal, or it may be above it, letting the input be near the bottom of the span so that you can see harmonics farther up. But, just as a scope has a variable horizontal rate, a spectrum analyzer has a variable span width. In other words, do you want to see 100 to 120 MHz, or 50 to 250 MHz? The wider spans let you see much more, but with less resolution at any given point, just as when you set your scope for a slow horizontal scan rate. On an analyzer, the control is called "dispersion." Setting a narrower dispersion, though, lets you see much more detail, at the cost of getting only a narrower slice of spectrum on the screen.

When you begin, you'll probably want to set the dispersion control for a fairly wide span, especially if you're looking for the harmonic content of your signal. Remember, the third harmonic will be at three times the operating frequency, so you'd better look far and wide. By the way, that's also why you can't use a spectrum analyzer to much advantage when your input frequency is anywhere near the upper frequency limit of the analyzer; you can't see the harmonics because they're above the limit. Luckily, most analyzers have limits above 1 GHz, making them useful at VHF and, to some degree, at UHF.

If you're looking for spurs or other signals much nearer your operating frequency, then you can narrow the dispersion control down, limiting the width of your view of the spectrum and giving you much more detail. Now you can clearly see the modulation around your carrier frequency, along with any nearby spurs or, perhaps, signals coming from other sources that could be causing intermod problems.

Get Vertical

What about the amplitude scale on the analyzer? How the heck do you look at a signal putting perhaps a milliwatt into the analyzer, and still see the tiny, microvolt-level signals that could surround it? That would take a phenomenal dynamic range that, in this case, translates to a screen several feet high! Essentially, you're stuck with the same problem that occurs in the horizontal direction: the trade-off between size and resolution. Here, though, there's no easy way out. If you scale down the vertical response, you can see the size of your incoming signal, but you won't see the tiny signals; they'll be too small to deflect the CRT's beam in the vertical direction, and most likely will look like a flat line, indicating nothing at all. If, however, you crank the vertical up, your input signal's main indication will go way off the top of the scale. The little signals, though, will be brought up enough in amplitude to be seen. Is that bad?

Fake It

Not necessarily. It does allow you to see what you want. It also, however, has two negative side effects. First, it prevents you from taking a visual measurement to compare the strengths of the carrier and adjacent signals. Sure, you can measure the carrier first, then crank up the gain, and lastly add the number of decibels you can no longer see, getting the number to add from the marking on the vertical amplitude control. Sounds messy, and it is! The second problem is even worse: When you crank up the input gain, you're likely to overload the input of the analyzer, because your input signal is now just too strong. That can cause false readings of spurious signals, because they're really being generated in the analyzer's overloaded front end. Clipping is clipping, no matter where it happens, and it'll cause splatter and distortion products that show up on the screen just as if your transmitter had caused them; they'll be indistinguishable from the real thing, rendering the measurements useless. Is there a way out?

Natch

Sure. Most analyzers have a special control that lets you set up a notch filter on your input frequency. Why do that? Well, now you can reduce the input strength of your primary signal, by a calibrated amount, but only on its fundamental frequency. That permits the other, adjacent frequencies and more distant harmonics to be unattenuated, and you can crank up the gain much higher without causing any overload. The result is that, although the display is no longer telling you the whole truth, you can see everything you want. All you have to do is add the attenuation value in dB, read from the notch filter's knob, to the displayed amplitude of the fundamental frequency, and you've got the true value of the fundamental, which lets you easily compute things like carrier-to-noise ratio and how far down the harmonics are. That's how those specs on our radios get measured. So, the notch is an important feature. Basically, that's all there is to know in order to use a spectrum analyzer for most tasks.

Other Uses

To tune a transmitter's output stage, you adjust its trimcaps and coils for the most power, right? Oddly, though, what looks like the most power on a wattmeter may actually be spread across various frequencies, thanks to distortion in the waveform. Wattmeters aren't sharply frequency sensitive, so they don't know where, spectrally, the energy is occurring. In fact, they're designed to be as frequency insensitive as possible. Remember, anything other than a sine wave will have power in more than one place in the spectrum. What you really want is the most power on the fundamental frequency, consistent with the least power anywhere else. While that may seem obvious, it isn't always strictly true! For instance, in a radio covering a wide frequency span, you may need to tune it for equivalent output power at the extreme ends of the span; tuning for

maximum at any one point could cause the power at either end to be way too low, or even for spurious signals to appear, due to mistuning. And, in the case of a wideband transmitter, such as an ATV unit or high-speed digital link, you may need to tune for equal output power within a defined portion of the unit's coverage—as always, of course, consistent with minimum power elsewhere.

What about receivers? With the right input signal, alignment of IF stages can really be eased with a spectrum analyzer. Unlike with transmitter alignment, you don't have a handy signal emanating from the receiver. Just connecting the analyzer to the IF output won't do you much good, because the results will depend quite a bit on what's coming in at the antenna jack. But, if you feed the receiver with a wideband noise signal while you're connected to the IF output, then you can see how the IF filtering affects the shape of the passband. For aligning wideband receivers like ATV units, this technique is invaluable, and TV shops used to do something very similar with a swept signal generator and an oscilloscope synchronized to it. In effect, they had formed a crude spectrum analyzer from other equipment.

Even in regular voice radios, setting up with an analyzer can show you things you couldn't otherwise see. If you feed the receiver with a single-frequency carrier signal, you can turn up the input level until the receiver overloads and then see how that affects the IF output. Or, you can connect the spectrum analyzer to the output of the first mixer, before the first filter, and see what intermod products you get and at what input level. If you're designing receivers or troubleshooting a stubborn intermod case, knowing the overload point, and its effects on the circuit, can be crucial.

I hope you've enjoyed this peek at spectral issues and spectrum analyzers. Before we go, let's look at a letter:

Dear Kaboom,

Why does my old tube transceiver's receiver actually sound better than my newer, solid-state, synthesized, whiz-bang rig? Shouldn't the new stuff be better? Signed, Quizzical.

Ah, a question relevant to this month's topic! There are two reasons your new rig may not sound as "clean" as old faithful. First, the old rig almost certainly doesn't have the sensitivity of the newer one, so you're hearing less band noise, QRN, and weak-signal QRM. Most of today's radios are way more sensitive than they have to be, or perhaps even should be. Really, who actually works stations buried in noise below S-1? Even if you do hear them, chances are they won't hear you! Besides, stations with better paths to them will undoubtedly be occupying their time. Most rigs have an attenuator button, which can help reduce the mess by putting some of it below the receiver's noise floor, but people seem afraid to use it, lest their S-meters read lower. It's silly; if it sounds better, go with it!

The second reason is harder to fix. Nonsynthesized radios have crystal-controlled oscillators, mixed with variable analog VFOs, controlling their operating frequencies. For all its limitations of drift and lack of memory capability, that old technology had the virtue of being spectrally cleaner than many synthesizers! Phase-locked loop (PLL) synthesis involves the constant correction of an oscillator by a digital control system. It works great, and offers the long-term stability of the digital system's timing crystal, which is much, much better than can be achieved with analog oscillators. But, the short-term stability is much worse, because the oscillator must start to wander a little before the digital controller can correct it. So, it's constantly wandering around and being readjusted, ever so slightly. That creates an effect called "phase noise," which is just a fancy way of saying that the oscillator has random modulation on it. It's small, but it's there, and it leads to a slightly fuzzy quality in the receiver, as well as on your transmitted signal. Newer rigs employing direct digital synthesis, in which the local oscillator signals are directly built up from digital pulses in CD-player style, are much cleaner, letting you enjoy the best of both worlds. I mention that all this is relevant to our topic because phase noise is a frequency-domain phenomenon, and can best be seen on a spectrum analyzer!

See you all next month. 73 de KB1UM.

Number 16 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

The Shuttle and *MIR*

When the Space Shuttle *Atlantis* went to orbit this summer on mission STS-71, changes were needed for the Shuttle Amateur Radio Experiment (SAREX) program. The primary goal of STS-71 was to dock successfully with the Russian *MIR* space station. The mission was accomplished. It was a historic first for both programs as the *Atlantis* and *MIR* came together.

For SAREX planners it was also a success, but several changes in ham-radio activity planning were required. Both the Shuttle and *MIR* have shared 145.55 MHz for ham activities. The cosmonauts on *MIR* use the frequency for simplex voice and packet operations. For the astronauts on the *Atlantis* it is the primary downlink for general voice and packet activity. During STS-63 last year, the Space Shuttle *Discovery* and *MIR* performed an approach test. The two spacecraft did not dock, but were very close for maneuver trials. Everything went well for a productive mission, but some difficulties were noted with using 145.55 MHz for both *MIR* and the Shuttle. *MIR* was running packet with the onboard 2 meter rig, Terminal Node Controller (TNC), and outside antenna. On the Shuttle SAREX operations included a Motorola radio and window antenna. Signals from the Shuttle were much weaker than those from *MIR*. Whenever the packet system on *MIR* transmitted, the Shuttle voice downlink was covered up. The window antenna on the Shuttle could not compete with the signal from *MIR*. Therefore, a change was needed.

The SAREX working group and AMSAT, the Radio Amateur Satellite Corporation, selected a new set of frequencies for use during future Shuttle-*MIR* docking missions. The new downlink was to be 145.84 MHz for general ham operations from the Shuttle. Two uplinks were also chosen: 144.45 and 144.47 MHz. During STS-71 the new frequencies were in use, but due to the intense level of operations associated with the docking procedures, there were few general contacts during the mission. Also, due to the lack of packet gear in conjunction with the Motorola radio (the primary use is Shuttle-*MIR* communications in the 121 MHz area), little was heard by earthbound enthusiasts. Unfortunately, future missions involving docking activities will likely have limited general ham-contact operation. The next SAREX use of the Motorola radio will come in October with the scheduled flight of *Atlantis* and mission STS-74. With Ken Cameron KB5AWP as Commander and Mission Specialist, and SAREX enthusiast Bill McArthur KC5ACR onboard, more general QSOs are possible. Keep tuned to 145.84 MHz and don't forget to listen for Shuttle downlink signals on other frequencies during passes that may involve scheduled school contacts.

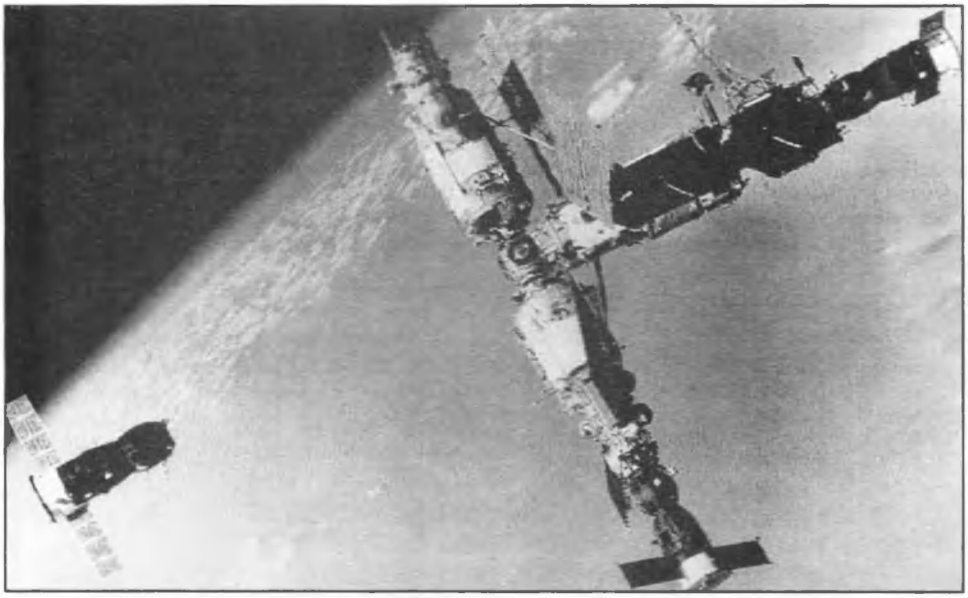


Photo A. The Russian MIR *space station with a Soyuz craft about to dock.*

MIR Activity

The core module of the *MIR* Space Station was launched in 1986. It has six docking units, which can receive up to six space vehicles the same size as

Photo B. Sergei U5MIR and Musa U2MIR (with ham-rig microphone) on MIR *(U5MIR photo)*

Photo C. Sergei Krikalev U5MIR does some soldering on MIR *(U5MIR photo).*

itself. In addition to manned *Soyuz* crafts, unmanned Progress cargo ships dock with *MIR* to replenish supplies. The docking units were designed specifically for the Russian space program, and differ from those used during the *Soyuz-Apollo* mission of the mid-70s. In order to dock with *MIR*, NASA needed to provide the required, compatible hardware on the Shuttle.

Interest in the *MIR* Space Station has increased since the docking activities of mission STS-71. Another positive result of the Shuttle-*MIR* docking missions is the increased interest in ham radio contacts with the cosmonauts aboard *MIR*. They have been active on 145.55 MHz FM simplex for many years. During a pass, voice, two-way packet, or packet BBS signals may be heard. Since the days of Musa U2MIR and Sergei U5MIR, many hams, including astronaut Norm Thaggard, using the call R0MIR, have been active on 2 meters from *MIR*. Sergei, on the other hand, has also flown on the Shuttle and has spent over two years in Houston for training and other activities.

During times of low activity from *MIR*, many have wondered if the crew was busy with on-board experiments, conserved power, or was just disinterested in ham activity. During most of these ham radio lapses the 2 meter ham rig has been in use for nonamateur communications outside the 2 meter band. This may soon change. A new 2 meter rig, TNC, and antenna are to be sent to *MIR*. This will allow one station to be used for the mission-specific work with Moscow, while the other can be dedicated to ham activities. This promises to be an exciting improvement for both the cosmonauts and hams on the ground. As before, the primary frequency for ham work will be 145.55 MHz. The orbiting packet bulletin-board system (PBBS) has been both interesting and useful for all involved and the occasional voice contact with *MIR* crew members is always an exceptional experience.

Photo D. Sergei U5MIR with wife, daughter, and Rita VK3CFI at the Johnson Space Center Amateur Radio Club Christmas dinner in Houston, Texas.

CARR'S CORNER

Continued from page 55

$$C7 = 100/(F_{MHz})^{1/2} \quad (2)$$

and

$$C8 = 1000/F_{MHz} \quad (3)$$

When making calculations for resonance or C7 and C8, allow about 10 pF for stray circuit capacitances.

The output of the NE-602 must be tuned to either the desired other frequency (F2) or the desired IF (that is, the difference between the received RF signal and the LO signal) by a tuned IF transformer (T1 in Figure 3). In most receiver projects, this difference frequency should be 455 kHz, 9 MHz, or 10.7 MHz, depending on application because of the easy availability of the coils and crystal filters.

Several sources offer coils, but perhaps the easiest to obtain are the Toko-brand coils marketed by Digi-Key (P.O. Box 677, Thief River Falls, MN 56701-0677; 1-800-344-4539).

Direct Conversion Receivers

You can use the NE-602 chip as a direct conversion receiver. In this type of circuit, the LO operates on the same frequency as the received RF signal for AM reception, and slightly offset for single-sideband—SSB (2.7 kHz)—reception. As a result, when the RF signal and LO signal are zero beat, the difference IF is the audio modulating the incoming carrier. In CW reception, the LO is tuned to a frequency a few hundred hertz from the incoming RF. In that case, the difference frequency will be a beat note that is interpreted as a CW signal.

To make a direct conversion receiver, simply replace the output network in Figure 1 with an audio transformer, and then follow it with a high-gain audio amplifier (see Figure 4).

You can use the NE-602 device for a wide variety of receiver, conversion, and other frequency translation problems. It can also be used as an oscillator or RF signal generator by connecting the oscillator circuit, as normal, and then connecting a 10k-ohm resistor from pin No. 1 to ground (and a 0.047 µF to ground from pin No. 2).

I can be reached for comments, questions, and criticisms at P.O. Box 1099, Falls Church, VA 22041.

RTTY LOOP

Number 17 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21200

Last month I highlighted one of the many sites on the Internet of interest to radio amateurs, the QRZ Home Page. I have been a bit taken aback by the reaction to this information, with the number of requests for more such sites. Well, the Internet is literally crawling with ham radio sites. That should not surprise you, given the nature of the Internet, and that hams have traditionally been in the forefront of innovative communication.

Ham Radio in Cyberspace

To begin, let's take a look at one of the services that can search out sites on the Net. The Galaxy site is one such service. Amateur Radio is under their Leisure and Recreation section, and setting your web browser to:
http://galaxy.einet.net/galaxy/Leisure-and-Recreation/Amateur-Radio.html
will take you to a multiple-paged list of links. Looking at the list reveals several books, discussion groups, commercial organizations, universities, ham clubs, and individuals. There are even several nonprofit organizations and government sources included. All in all, this is a good place to get started.

Lou Williams KE4ARM manages an Amateur Radio Web Server from Raleigh, North Carolina. This is another example of a focus on the net that allows you to look at the Amateur Radio NewsLine, information on SAREX missions, callbook servers, the online repeater database project, and latest FCC rules and regs, and, of course, to download some of the latest software. You can get to this site at URL:
http://www.acs.ncsu.edu/HamRadio/

Geoff GJ4ICD maintains his Ham Radio Pages, "The World's Hotspot For Amateur Radio Information & News" from New Jersey. This is a huge listing of links for amateur radio, including just about every available facet of the hobby: the ARRL, European groups, antennas, and much, much more. As with many of these servers, it provides the "taking off point" for many other directions on the worldwide web. Take a look at Geoff's efforts at URL:
http://user.itl.net/~equinox/

As I mentioned above, there are several commercial interests addressing the needs of the radio amateur on the Internet. Our old friend Kenwood is one of them, with their Kenwood Communications Corporation Amateur Products Group North America Home Page. No, you don't have to type all that in, just the URL:
http://www.accessnv.com/kenwood/

On that server you will find the "Kenwood Report," dealer list, new stuff at Kenwood, and, of course, links to other sites. This is, after all, the webl A different kind of site may be found at URL:
http://wb5fnd.tech.uh.edu/irc/

This is the #HamRadio Home Page, home of the ham radio access to the Internet Relay Chat (IRC) network. The IRC is as close to a free-form QSO as you are likely to find in cyberspace at this time, and may be one-on-one or roundtable in form. Adequate information is provided for the novice to get started but, as with anything, the best way to learn is to jump right in.

How about practicing for the next licensure exam? The Ham-Exam site, managed by Stephen McClaran KK5QE at URL:
http://w5ac.tamu.edu/ham-exam.html
can help you by generating random questions from Novice, Technician, General, or Advanced levels. He is working on including figures for some questions, and adding the Extra level.

Not to leave out the packet crowd, how about The Packet Radio Home Page, found at URL:
http://dingus.n5lyt.datarace.com/tapr/pkthome.html

Lee Ziegenhals N5LYT hosts this page, prepared by Howard Goldstein N2WX in Sebastian, Florida. It features packet radio pages, archives (a virtual library of packet information), and a link to the TAPR Home Page, the nidus of packet, everywhere.

Not all of us have the latest callbook, but the Buckmaster World Wide HamCall™ Server can help those of us with Internet access find out who's who. By looking at:
http://www.buck.com/cgi-bin/do_hamcall
you can access a callsign search engine that can look up just about any callsign you can give It.

The last in this month's series of sites is another overseas location, the Amateur Radio WWW site of DK0TUI at Technical University of Ilmenau, Germany. There are collections of information on amateur radio in German as well as English, together with links to other servers. Take a look at URL:
http://www.systemtechnik.tu-ilmenau.de/ham.htmi

Do you have a favorite site you think others should know about? Send it to me here, at RTTY Loop, via any of the addresses at the end of the column. I'll try to include at least one per month in future columns. While plans are still quite sketchy, there is even the possibility of a RTTY Loop Home Page in the works. So, as they say, stay tuned!

Now, for those of you to whom much of this URL and http:// stuff is so much gibberish, a few words of advice. If you have a computer and a modem, getting onto the Internet through one of the commercial services is really very easy. Yes, you can save some money by connecting directly to the Net through a local Internet provider, but you may have to jump through a few hoops to accomplish it. On the other hand, if you can connect through CompuServe or America Online, it is about as easy as going to any other place on the service.

Not on a major service? I am sure that most of you have seen or received an offer for America Online, if not others, to try it out for a bit for free. Go ahead, give it a try. If you have absolutely no idea of how to get started, drop me a note, with a self-addressed stamped envelope if by snailmail, and I'll send you some simple things to try.

I devoted this month's column to online amateur services because the demand for software seems to be growing. At least that's how many of your letters and E-mails sound when inquiring about the RTTY Loop Software Collection. Now up to 10 disks, it is a reasonably cheap and easy way to acquire a wide variety of radioteletype, packet, SSTV, CW, and other ham utility programs. To get the latest listing, and details on how to obtain the software, drop me an E-mail message, at 75036,2501 on CompuServe, at MarcWA3AJR on Delphi or America Online, or at MarcWA3AJR@aol.com via Internet. Of course, a piece of USPS Snailmail sent to the address at the top of this column also works, if you enclose a self-addressed, stamped envelope for the reply.

QRP

Number 18 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Receiver Incremental Tuning

As more hams take to the low bands, things can get a bit messy. I would guess that every commercial rig has a RIT, or Receiver Incremental Tuning control, built in. But most of the QRP rigs I've used in the past don't have this very useful feature. In fact, it took Heathkit three tries to finally add an RIT to the HW-9 QRP transceiver.

What is RIT?

In its simplest form, RIT is a circuit to allow the operator to vary the receive frequency up or down a few kHz. Most RIT circuits have a frequency spread of plus/minus 1.5 kHz. Now, it's very easy to move the frequency of a VFO. In fact, most of the VFO circuits I've built in the past moved all by themselves! The trick in designing a practical RIT circuit is to keep the RIT from screwing up the VFO.

Let's look at a few ways in which we can move the frequency of a VFO. A trick used way back when is to place an inductor in series with a crystal. By switching in various amounts of inductance, you can change the frequency of the rig. There are some drawbacks to this method. First, you can't lower the operating frequency by a great amount. Second, the amount of inductance is fixed by the coils selected. If you need to move your receive frequency between the selected inductors, you're out of luck. A variable inductor could be used, but then you must worry about keeping the tuning linear. Third, this method only works with crystal-controlled rigs. Also, if you add too much inductance, your crystal-controlled rig becomes an all-bander.

The very same idea can be accomplished by using several small fixed capacitors. You select the amount of offset by grounding a capacitor connected to the tuned circuit of your VFO. You end up with most of the problems you get when trying to use inductors. The old-fashioned "bandspread" control used in the older radios is a prime example of this type of circuit design.

By far the most popular method to date is to use a varactor diode across the tuned circuits of the VFO. A RIT control voltage is applied to the diode and its capacitance can then be varied. Since the control voltage is generated by a pot, there's no direct connection from the RIT control and the VFO. Also, the RIT may be turned on and off at will.

Now that you see how to vary the frequency of an VFO ever so slightly, you must also be able to return the VFO to the proper frequency during transmit. And this is the part that gets tricky!

During key-down, you must return-disengage the RIT. Return the VFO to the transmit frequency. Mute the receiver. Switch the antenna to the transmitter. Key the transmitter. All of these steps must be done in the proper order and all within a few milliseconds. The steps are done in reverse when you're through sending. Add on the complexity of full break-in keying and whoa!—things begin to get sticky. To make things even more interesting, you need some way of turning the RIT off without affecting the frequency of the VFO. Then, there's the problem of finding the center of the RIT control. Add up all of these tasks, and you'll see why adding in a RIT is not as easy as it sounds.

No Need to Panic!

But, take heart, you can design in a RIT for most rigs. In fact, here is a RIT that you can install in the original version of Dave Benson's 20 meter transceiver.

The circuit is rather basic. A varactor diode is used to add capacitance to the VFO's tuned circuits. A panel-mounted pot is the RIT control. You can place this pot anywhere on the rig to suit your liking, without the worry of keeping leads short. For the best performance, a center detent pot would be a great idea. Check out Digi-Key and Mouser for suitable controls. Here's a thought: Ten-Tec, Kenwood, Icom, and the others all have or have had center detent controls on the equipment. You could use a replacement part in your new design. All you need is a part number, and a good place to find that part number is a service manual. As a benefit, you can also order the matching knob set while you're at it.

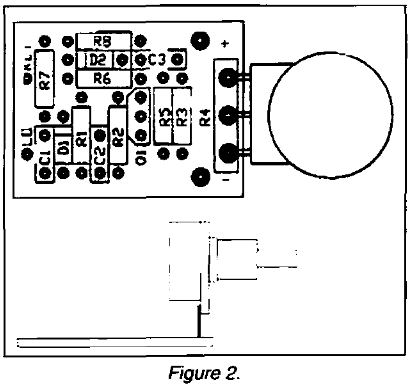


Figure 2.

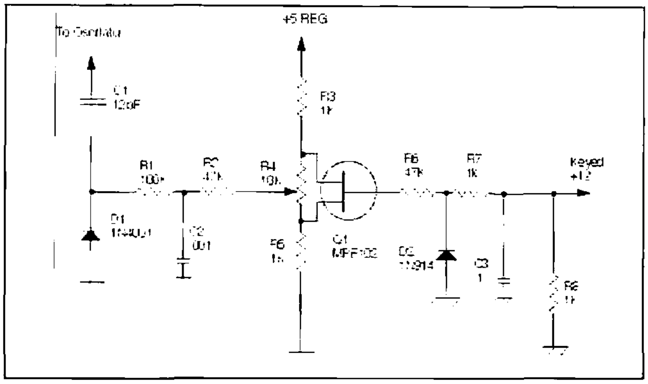


Figure 1.

A RIT Circuit

Take a closer look at the schematic of the RIT circuit. This circuit was designed by W6EMT and you should contact him if you need more information. Construction is best done with a PC board, but point-to-point wiring will work just as well. There's nothing really critical about the circuit. Just keep your leads short to the parts going to the VFO. You should use a stable supply voltage to operate the RIT circuit. If the rig you're putting this into does not have a regulated VCC line, a 78XX series regulator will work. Remember, unless you plan on using a low drop-out regulator, a 7812 will not provide a stable +12 volts from a 12-volt power source. I have used a National LM2940CT-12 (Digi-Key part number 9192B-ND) with good results down to 12.4 volts input. The LM2940CT-12 costs about $2.50 in single-lot quantity. Be sure to bypass the input and output of this low drop-out regulator the same as you would with any other 78XX series regulator.

As I mentioned, this RIT is designed to go directly into the rig designed by Dave Benson. If you plan on using this basic circuit for another rig, check to make sure the VFO is operating as it should before you add on the RIT. Some (at least the ones I built) VFOs may not like the added capacitance and stop oscillating.

Many times, adding on an extra circuit such as this will cause the keying of the rig to become all screwed up. Check for proper keying by using your 'scope or by having a close-in ham buddy listen to your signal. The keying should be clean and well shaped after you install the RIT modification.

Although you may never encounter this problem, I've read stories about light hitting the diodes and causing their capacitance to change. If you notice this, apply some black paint to the protect the diodes from the light. Or a strip or two of black plastic tape will work just as well.

Another thought when you're working with add-on circuits to your VFO: Be sure you use some means of holding the parts down on the circuit board so they won't move about. I've been using hot-melt glue and find the results to be just great. It takes a bit of a time to get the glue off the board if you need to replace defective parts, but then who ever said life was perfect?

RIT Assembly

( ) R1	100K resistor
( ) R2,R6	47K "
( ) R3,R5	1K "
( ) R4	10K control
( ) R7,R8	1K "
( ) C1	12 PF NPO
( ) C2	.001 ceramic
( ) C3	.1 "
( ) D1	1N4001 diode
( ) D2	1N4148 "
( ) Q1	MPF102 transistor

Check off the parts as you install on the PCB.

Check for solder bridges, shorts, opens, etc.

Mount the control/PCB assembly as required.

Connect +12V as shown.

Connect ground as indicated.

Connect the LO cap to the VFO main tune capacitor

TEST
Apply power to the receiver. To find the RIT control center. Connect a VOM to R4 pot center pin. Apply +12V to the key line at R8. Note reading on VOM. Remove the +12V from the key line, and adjust the pot R4 to the same VOM reading. This is the RIT center.

HOMING IN

Number 19 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KOOV
P.O. Box 2508
Fullerton, CA 92633

Hunts and Stunts Around the USA

Imagine going to a football or baseball stadium that doesn't have a scoreboard. Imagine also that final scores aren't published for weeks after the games end. It sounds absurd, but that's the way most ham radio competitions work.

When you finish competing in a QSO party, Field Day, or a DX contest, you have only a vague idea who the leading competitors were and how well you did against them. You won't find out the winners and all the details until months later, when the official results are printed in a magazine.

On the other hand, when you go hidden transmitter hunting, you'll know exactly who you are up against and you'll usually find out how well you placed before you go home. After a mobile hunt, you will probably end up at a lively post-mortem session with plenty of success and failure stories, either at the hidden transmitter location or a nearby restaurant. Later, there will be lots of chatter about past and upcoming hunts on the local repeater.

Last month, I explained the basics of this fast-growing radio sport, which most hams call "T-hunting" or "foxhunting." In a nutshell, it's ham radio's version of hide-and-seek for all ages. Participants track down the location of well-placed transmitters using easy-to-make radio direction finding (RDF) equipment. This month, I'll tell about some creative ways that hams around the country are having RDF fun.

Surprises Guaranteed

Most T-hunts in North America involve miles of driving in RDF-equipped cars, trucks, vans, and even motorcycles (see Photo A). After the mobile portion of the hunt, it's often necessary to "sniff out" one or more concealed Ts on foot (see Photo B). Besides experiencing the instant gratification of knowing how they did at the end, hunters like this challenging sport because, when they start out, they never know where they will end up and they are never sure what they will find there.

If you go foxhunting at Halloween time, maybe you'll track down a pumpkin! A couple of years ago, Randy Skirvin N6KHO and son Brandon KD6MMZ cut a small hole in the bottom of one and replaced the innards with an Alinco 580 transceiver. They placed their pumpkin-T under a pine tree in a park for the monthly T-hunt of the Amateur Radio Club of El Cajon, California. It might have been just a bit obvious there. What if they had left it in a patch with dozens of other pumpkins?

Jim Bowman W7HPK, Direction Finding Coordinator for a RACES group in the Seattle area, recently wrote about a T-hunt he and his wife Betty put on: "We spotted an old barbed wire fence around a pasture next to a church in Lynnwood. On closer examination, I discovered that it included an old, unused strand of electric fence wire. That did it! I found a spot where the fence wire came close to the ground and hid the transmitter and battery right under the fence in the bushes. I had made a temporary antenna from a 19-inch piece of insulated wire, which I wound around the electric fence wire to couple the signal to the fence. (Who worries about SWR?)

"Some carefully arranged grass and flowers picked nearby completed the camouflage of the rig. Betty and I obtained permission to conceal ourselves inside the church to watch the proceedings (a kind term for a pack of frenzied T-hunters beating the bushes). After about half an hour, we saw the first signs of them. One team pulled right into the church parking lot, drove in a circle, and came back out. Shortly thereafter, they pulled in the park-

Photo A. Who says quads have to have square or diamond-shaped elements? Dave Hess KD6LZA has great results on meter T-hunts with a circular-element quad.

Photo B. Most hidden Ts aren't alongside the road, so "sniffing" gear is required. Marty Mitchell N6ZAV is well equipped with a Shrunken Quad, Sniff-Amp, handi-talkie and active attenuator. The object of his search is atop the playground equipment.

ing lot again and stopped about 50 feet from the hidden transmitter."

Then the fun intensified, as more teams arrived and the on-foot portion of the hunt began. "The first team went in opposite directions up and down the fence line," Jim continued. "For awhile there was a confused mob wandering along the fence. The long-wire antenna was making sniffing tough. I was really whooping it up in my hiding place, loving every minute of watching the best teams we have working so hard to find a transmitter right at their feet.

"This frenzy continued until Tom Bruhns K7ITM finally spotted the transmitter and raised his monster yagi in the universal victory sign. It was impossible to determine any other finishing positions because everyone was so close that when Tom found it, everyone knew. This was the hardest I had ever seen so many T-hunters work, for so long, and so close to a transmitter without finding it!"

Safe and Sober Hunters Only

Over the years, I have written articles about hiders who put Ts in unlikely places such as baby carriages, shopping carts, ferris wheels, and fake fire hydrants. Jami Smith KK6CU tried to outdo them all this spring on the weekly Friday night hunt in the San Gabriel Valley near Los Angeles. "This is a 'find it quick and hurry to the restaurant' type of hunt that normally lasts a half hour to an hour," he told me. "On the Monday before the day I was to hide, I went to my Temple City Ham watch meeting as a volunteer for the Los Angeles County Sheriff's Department. They needed volunteers to help out at a sobriety checkpoint, so I raised my hand and they signed me up. Then I remembered that I had to hide the T that night.

"Now during the meeting, our Ham watch leader, Lola Lowe KE6JDW, mentioned that she wanted me to plan a demonstration T-hunt for some of the deputies," Jami continued. "That started me to thinking about combining the two. I explained my idea to her and she checked with the sergeant. He is a pretty straight-laced guy, but he said that as long as my transmitter was safe and out of the way, it was okay.

"But when I arrived Friday night, the sergeant was not at the checkpoint and he had not talked to anybody who was there. I approached one of the deputies and he told me I could put the T in my parked car, right at the checkpoint. My original plan had been to put it in one of the traffic cones in the middle of the lanes, but this worked out fine. Without giving away my location, I instructed the hunters to pay particular attention to their driving and for them to approach whatever they thought was the T—only one at a time. A few people were hesitant to drive down the checkpoint street with their RDF vehicles, but we had a great time and everyone thought the idea was pretty neat."

"After the mobile portion of the hunt, it's often necessary to 'sniff out' one or more concealed Ts on foot."

In most cities and towns, rules for T-hunting are straightforward and simple. They specify the boundaries, hunt frequency, and scoring method. The winner is usually the team that finds the transmitter first or the one having shortest start-to-finish odometer mileage. In other places such as the Grand Rapids, Michigan area, foxhunt rules have interesting twists.

According to Sam Nabkey WJ8T, hunts begin at 6:30 PM Saturdays at a Red Cross Building. Boundaries include all of Kent County. The hider asks one participant to be huntmaster, assisting at the starting point. To insure that all participants drive safely, each vehicle operator gives his or her driver's license to the huntmaster, who places it into a sealed envelope and gives it back to the driver. The huntmaster writes down the starting time and mileage on this envelope, too. "By doing this, we can tell at the end if any team has been pulled over by the authorities for unsafe driving," Sam says, "because the seal on the envelope will be broken. That hasn't happened . . . yet."

Grand Rapids hunters have an unusual scoring system, too. A few hours before the hunt, the hider covertly drives the shortest route from the Red Cross Building to the hiding spot, determining the minimum possible mileage and elapsed time. When a hider finds the T, his score is calculated by computing two fractions, minimum mileage divided by actual mileage and minimum driving minutes divided by actual minutes. Each fraction will be less than 1, unless a team manages to take less time to drive the course than the hunter did, in which case that fraction is declared to be 1. Each of the two fractions (for mileage and time) is multiplied by 50 and the two products are added together to give a team's final score. The highest scoring team wins. This scoring method sounds complex, but each score takes only a few seconds with a hand calculator. For example, if a beginning team finishes with twice the minimum mileage and takes four times as long as the minimum time, its score will be 37.5 out of a possible 100.

Grand Rapids hiders like to announce scores as the hunters come in. This can be demoralizing when you're stuck without a good bearing and you hear the hider say that one of your competitors just found him and scored 85 points!

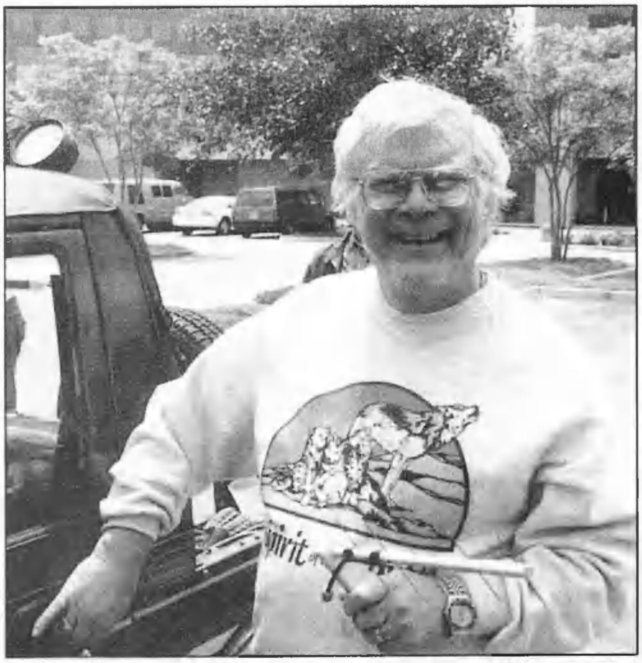


Photo C. Bob Thornburg WB6JPI shows off a home-brew 1.2 GHz yagi he built for the 1995 West Coast VHF/UHF Conference T-hunt. He made two—one for his rotating mast and the other for sniffing.

Not For Weekends Only

Is it hard to find time in your busy schedule for RDF? Want to stay fit and have fun at the same time? Dave Sims KC5JKN has the answer. "Our little radio club here in Los Alamos, New Mexico, has been doing T-hunts on our lunch hour," he says. "All of us work in the same place, we got our licenses in the last year or so, and we all like to bike ride. We work next to a residential area that's nice for riding. At the start, we give the fox about 10 minutes while we eat lunch. He rides out, usually to a cul-de-sac or dead end street, never much more than a mile from where we start. He sits down, eats lunch, and starts talking or reading a book into the mike.

"The first person to get there wins. We do it on 2 meters and the hider tries not to make it too hard," Dan continues. "We stop when we have about 15 minutes left. When the fox is ready to go back, he starts giving obvious clues."

KC5JKN is looking at ways to mount RDF equipment directly to his bike, because his present method is cumbersome. "We all use handi-talkies," he says. None of us knew how to do RDF at first. We read somewhere that you can hold the HT close to your body and turn in a circle to listen for body blockage of the signal. Unfortunately, you have to get off the bike to do that. "I use the rubber duck and when I get close, I

remove it. Sometimes I use a 2-inch piece of wire as an antenna when close. Another person keeps the rubber duck on but holds it with both hands to shield it when close. It's tricky because a lot of times the fox will be eating his lunch and not transmitting when you need a signal."

Indianapolis hams have found a way to go RDF contesting without having to ask a ham to be the hider. Cliff Vaught N9FHF wrote on CompuServe's HamNet: "We have both monthly hunts and impromptu hunts. The traditional hunts are on Sunday afternoons. The spur-of-the-moment hunts are usually at night, often during the week."

N9FHF continues, "Around 10 PM or so, after my fellow crazies have put their kids to bed and other chores are completed, we congregate on our favorite repeater frequency. Our scanners are also going, looking for a signal to hunt. It could be an errant one or just a strange-sounding one. It's usually 6 meters or higher and most often around 2 meters or 70 cm, as that is where most of have equipment ready to go. The signal could be ham, business, government, or anything else that's out there.

"When a worthy signal Is found, a 'CQ Foxhunters' call goes out. After everyone has tuned it in and agrees that it is worth the chase, the hunt is on. Afterwards, we always retire to a restaurant to compare notes and discuss the evening's activities. This usually gets us home between 1 and 3 AM. Most of our wives have become so accustomed to this that they don't wait up for us any more."

First T-Hunt on 23 Centimeters

Southern California T-hunters have done their sport on every band from 28 to 450 MHz in recent years. Knowing this, the organizers of the 1995 West Coast VHF/UHF Conference in Cerritos decided that it was time for RDF on a new band. The last event of the Conference was a mobile hunt featuring several 2 meter Ts and one on 1.2 GHz FM. To win, a team had to have low mileage to the 23 cm band emitter and shortest time to all the foxes on 146.565 MHz. Some teams DFed the new band with a short or long yagi on a rotating mast (see Photo C). However, the winning team of Gary Holoubek WB6GCT, Don Frizielle W6HRC, and Jason McLaughlin KD6ICZ did it much more simply. All they used for microwave hunting was Jason's handheld with a little five-element J-beam plugged into its BNC antenna connector.

"I was sitting in the back holding the handheld out the window, not expecting to hear much," Jason says. "Our strategy was that I would listen to 1.2 all the time and the guys in the front would T-hunt 2 meters as usual. We figured that the 1.2 T would be near one of the 2 meter Ts, so we would hunt 146.565 MHz and if the 1.2 GHz signal came up, then we would go find it. "As it turned out, there was an S-3 microwave signal at the starting point and I got excellent bearings on it the whole time. We ended up turning off the 2 meter radio and hunting the 1.2 GHz signal first, because we decided that if we could get great mileage on that one, we could spend the rest of the hunt pedal-to-the-metal finding the 2 meter Ts."

I have lots more tales of unusual T-hunts from all over, but I'm out of room for this month. If you want more "battle stories" in future "Homing In" columns, let me know. While you are at it, send details and photos of the hunts in your home town. Write to the address at the beginning of this article or send e-mail to me via Internet (HomingIn@aol.com) or CompuServe (75236,2165).

When you contact our advertisers, tell them that you saw their ad in *73 Amateur Radio Today!*

Number 20 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Mars Base Simulation

One of the best ways for teachers and instructors to get new ideas is to share with each other. That certainly is a primary goal of this column. One of my ham radio acquaintances who is a super creative teacher is continuously coming up with innovative teaching projects. Dave Reeves KF6PJ is a teacher at Chaminade College Preparatory School. We met several years ago at a NASA Educators' Conference at the Kennedy Space Center. Since then we've kept in touch and shared some great teaching experiences.

Mars Base Omega

On June 2 and 3, Dave and fellow teacher Margery Weitkamp KA6OCL led the honors topics class at their school in West Hills, California, in a 36-hour Mars Base simulation. Dave tells me that everyone connected with the project had a great deal of fun. I'll share what Dave wrote me about this exciting learning experience that he and Margery helped orchestrate.

The two classes moved the science experiments that they had been preparing for the entire school year from Margery's biology classroom, "Lunar Base Alpha," into newly constructed "Mars Base Omega." Heather KE6RRD and her module group designed and built the Mars base by covering a frame of 4-inch PVC pipe with sheets of translucent plastic. For 36 hours, base leaders Mike KE6QNT, Steve KE6QNU, Kristen KE6UJH, and Jon KD6FOZ guided teams of three or four classmates. The teams worked in 2-hour shifts, reporting results from Mars Base Omega to the command post in Dave's physics classroom, "Lunar Base Charlie."

Students sent reports on scientific experiments, base temperature, solar electricity battery voltages, and crew temperatures and respiration rates. They typed and sent packet radio reports every half hour on their "Data Link." They kept continuous 2 meter radio voice communications while they watched one another on closed circuit TV. For two days and a night, the 2 meter ham radio band was ablaze with the chatter of the 39 teenage amateur radio operators exchanging information such as "Phoebe (one of the base chickens) just laid her first egg."

Photo A. Mike Spasoff KE6QNM and Dan Radovich KE6SOO transmit GPS data from the Mars Rover.

Mars Rover

John KE6UJM, Jacob KE6UND, and Mike KE6UJJ completely renovated an old golf cart in the ground's maintenance shed, transforming it into the proud "Mars Rover." And rove it did! During the entire simulation, the Rover Group automatically transmitted their GPS position to the command post in Base Charlie. They maintained 2 meter voice contact. A computer in Base Charlie Used APRS software to display their changing location. Satellite ground station transmitted a picture of the Rover to Pacsat during the event.

Satellite Ground Station WA6BYE

Greg KE6PND and Rob KE6PNF ran a unique special events station by contacting the Pacsat Satellite on every pass over the 36-hour period. They enjoyed several exchanges with Jan ZS6BMN, who reviewed their Mars Rover picture in Pretoria, South Africa.

Mars Expedition

On March 27, 1995, the honors topics classes rehearsed the Base simulation by taking their Rover to the Santa Susana mountains overlooking the historic Rocketdyne Field Laboratory. Teams explored the "Mars environment," locating plant, animal and rock specimens. They reported their findings to the command post over 2 meter voice radio. The Rover transmitted its position from its GPS receiver to the command post on 2 meter packet radio using software created by their advisor, Mike Tweedy KA6SPT

Lunar Base Alpha—Margery Weitkamp KA6OCL, Teacher

The plant group, led by Luigi KE6QVU, designed a hydroponics system and grew genetically engineered "Brassica rapa" plants. They gave the plants to Eric KE6QVS, the biotechnology group leader, who extracted the genetic material and used electrophoresis to characterize the different strains of DNA. Biotech team members Caryn KE6THF, Pratima KE6QVV, and Travis measured the fertilization rates for sea urchins in different salinity, and obtained classic results.

Jennifer KE6TZD and Amanda KE6UNB used four chickens to measure the egg production, density, and shell thickness as a function of various day/night proportions. Kyle KE6TTZ, Danielle KE6QVR, and Curtis did an exhaustive study of crayfish. They took plaster casts of their boroughs in several simulated Mars soil types.

The Celestial Navigation Team used a computer program to simulate the trip from lunar orbit to Mars. Chuck KE6TGZ, and Rachel KE6UQN enacted a simulation of the trip to Mars over the 2 meter com link.

Lunar Base Charlie—Dave Reeves KF6PJ, Teacher

The GPS group, Mike KE6QNM, and James KE6QNL, mounted an Eagle GPS receiver, a Tiny-2 TNC, and an HT transceiver on the Mars Rover. They tracked the Rover's position on a computer in Lunar Base Charlie using APRS software. Richard KE6RRF, Vanessa KE6RVL, and Kevin established the "Data Link" using packet radio. They operated from a laptop computer and an HT transceiver in Base Omega.

Mike KE6QNT and Steve KE6QNU did extensive work on a fiber optics data link. It was not, however, fully operational at the time of the simulation.

The public relations group published the articles submitted by each group in a 16-page booklet called, "Mission 2 Mars."

Editors Mike, Mark, and Brian also produced a video containing Patrick KE6QNP's animation of the Rover, the Base, and the Martian terrain. They obtained most of their images from the WWW on the Internet.

During the Mars Base simulation, Nilou KE6QVT prepared an excellent weather report from one of the NOAA weather pictures that she acquired directly from the satellite. The occupants of the Mars Base were grateful for the cool and cloudy June gloom.

The Power Systems Group, Amy KE6RVN, Sean, and Fernando set up the solar power electrical system used to power radios, computers, and lights in the Mars Base during the simulation.

Jon KD6FOZ and Brian KE6QWE established the com Link between Command Base Charlie and Mars Base Omega. They used 2 meter radios for voice and closed circuit video for the television signals between the two bases.

In Summary

According to Dave, the students mastered the science and the technology skills needed to operate both Mars Base and the Rover. The students were responsible for all aspects of designing and setting up the base, and for its subsequent operation. As teachers, Dave and Margery were excited about how well the young people exercised leadership during the mission. They were also pleased with how the students were able to train one another in the operation of the experiments and the packet radio system. For their part, the students were surprised that even while they were learning, they were having a good time.

For more details about the Mars Base Simulation project, contact Dave Reeves KF6PJ at Chaminade College Preparatory School, 7500 Chaminade Avenue, West Hills, California 91304.

Photo B. The command post in the field on March 27.

Photo C. David Reeves KF6PJ and Greg Flowers KE6PND speaking about ham radio for the bases.

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

Surplus Ideas for GOES 1691 MHz Converter

Well, I had to do something on this topic sooner or later. I have had so many requests and letters all commenting how on a limited budget a GOES Weather Satellite receive converter can be constructed. Usually the converter in question takes the form of a downconverter to 137 MHz, where the VHF receiver and existing system is used for VHF WEFAX. By using existing hardware at 137 MHz for WEFAX, this project necessitates the construction only of an RF amplifier, mixer, and local oscillator. The trick is, of course, to keep the project low in terms of cost to remain within budget.

System parameters dictate that the system should have a noise figure of 2 dB or less and gain of about 15 to 20 dB minimum in the RF preamplifier. More gain and a reduced noise figure would be nice, as this would allow a margin of extra performance to allow for signal variation.

Now, the hardest part is trying to put together a system on a shoestring budget. That's always the hard request to fill, but we will give it a try and tackle that problem head-on. What I have to offer is not a complete PC board layout for construction but rather a set of conversion ideas that in part will allow you to construct a good portion of a 1691 MHz receiving downconverter from surplus material that should be available in your local area. After all, if you can't find the surplus material, you can't construct this low-cost converter. Lets take the problems of our surplus material one-by-one starting, with the RF preamplifier.

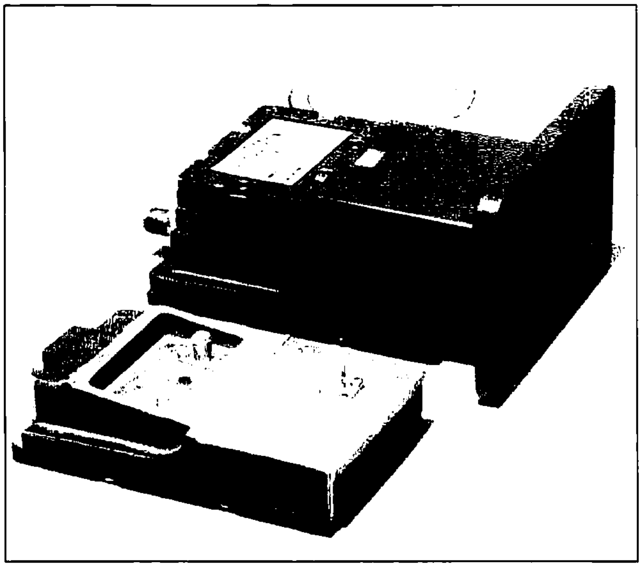


Photo A. Both the modified and original LNB.

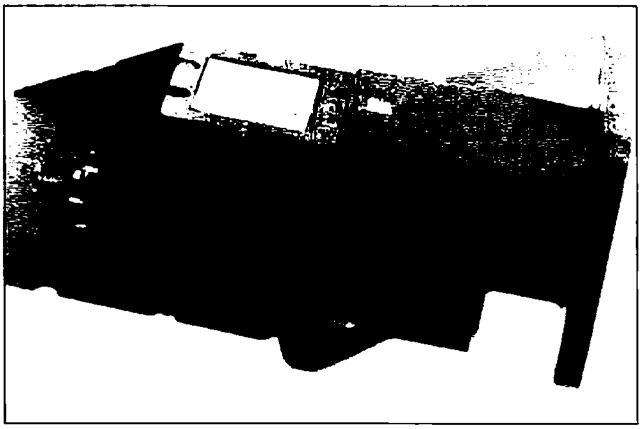


Photo B. Original LNB for 3.7 to 4.2 GHz TVRO operation.

The biggest problem in any high-sensitivity downconverter is, of course, the receiving RF preamplifier that must have lots of gain and a good, or low, noise figure. Given that, other components required include a mixer and possibly an IF preamplifier in addition to the all-important local oscillator. We will handle the local oscillator problem last as this will be a problem to solve in next month's column. This month, I want to present ideas that can be put into motion so that we can take the finished form next month. I like to work with deadlines as they tend to make creative ideas sprout faster rather than waiting for something to happen. I call this sort of a creation research crash program. Now, back to surplus-material renovation.

What, then, is available in common surplus material that can deliver the basic design considerations and fill the bill? Well, what's more natural than to use the very surplus old standby TVRO 3.7 to 4.2 GHz Low Noise Amplifier (LNA). Prior use of surplus LNAs al other than TVRO frequencies have proved successful in a general-use amplifier. Putting this same LNA back to service in the 1691 MHz frequency range is not a problem. The basic converted amplifier showed good usable gain from 800 to slightly over 4 GHz when modified. Be aware that the gain is not uniform across the frequency responses when the bandwidth is opened up to cover 800 MHz to 4 GHz. Variation is great but consider that the original gain was some +40 dB in the 3.7 to 4.2 GHz range.

The conversion is quite simple, since all that is required is to remove the frequency determining stripline components between amplifier stages. By removing the frequency-determining trim stubs, the amplifier will be changed from a relatively narrow band unit to one of wide bandwidth. The finished stripline will look like the devices are all interconnected by just a 50-ohm or so stripline with no frequency-peaking stubs. If you are a real perfectionist, you could even try your hand at improving gain at the 1691 MHz frequency if of interest (snowflake tuning). I haven't tried this but suspect that you can obtain some success with this improvement.

A normal (stock LNA) amplifier provides about 40-50 dB of gain in the 3.7 to 4.2 GHz TVRO band. Now there is usually lots of excess gain to play with making broadbanding quite practical. The type of LNA you happen on to for this conversion is not important as long as the cost is low; usually surplus LNAs can be had for about $4 to $5 each. As I said before, a surplus LNA has about 40-50 dB gain and, even after conversion, these typical amplifiers still provide at least 30 dB of usable gain. Of course, there are peaks and valleys in this wide bandwidth mode but, with a little retuning effort, I am sure that you will have good results making the preamp work at 1691 MHz.

The rest of the conversion requires a mixer and for embellishments an IF preamp, if you desire. Now with this in mind you might be able to pick up a variation of the LNA—namely, the LNB. This is a unit that not only incorporates an RF preamplifier but a mixer and usually an IF preamplifier. If you can find one of these LNBs, it would save a few dollars on conversion and provide more gain as the IF amplifier can be brought into play.

The conversion scheme with an LNB is a little more complex because the unit has an internal local oscillator, usually a Dielectric Resonant Oscillator (DRO). Unfortunately this oscillator cannot be modified to work for our conversion and needs to be removed, as intact as possible, for some future project. With the DRO removed in most modules, there is space available to place a small voltage-controlled oscillator. In the unit that I converted, I just removed the entire metal wave guide flange to eliminate bulk not required in our converter. I mounted a coaxial connector to connect an external LO of choice. More on the local oscillator later.

Removing the DRO leaves the basic RF preamplifier for conver-

sion using the same procedure as in a stock LNA. The IF preamp that comes with an LNB needs attention, as it operates in the 1,000-MHz range and is frequency restrictive due to its low-value frequency coupling capacitors. To lower the frequency response to the 137-MHz range, all that is required is to increase the interstage coupling capacitor's value, thereby lowering the frequency of operation. For an IF of 1,000 MHz or so, the value should be very small—say. a few pF—but with an IF in the 137-MHz range, a value near 10 times the original is normal. This one conversion will improve the low-frequency coupling and lower the operating frequency of the IF preamp.

Modifying the LNA or LNB housing to remove the waveguide flange is best done with a good bandsaw to eliminate most of the LNA's case. A hand hacksaw could be used, but the effort required is almost superhuman; I know, because I tried my hand at one on a hot California day. You can remove quite a bit of metal, as is evident in Photo A, which shows both a stock and converted LNB. As you can see, the profile of the converted unit is quite small. Before you are ready to take a whack at the metal, make sure the PC board will survive; either remove it or take a chance and leave it in place. (That's if you have several units available to check out G-force survival on your band saw "shake" table.) I removed the complete PC board assembly and left the minimum amount of material connected before sawing, using good static-free procedures to afford FET-device protection.

When you remove the PC board, make a sketch of the interconnecting leads and be sure to include details showing how the leads were attached and the wires dressed. A simple sketch will jog the memory, as most will fall into place. But do not leave it up to chance; make the drawing or sketch showing where everything attaches.

After the waveguide section is removed from the LNA housing, drill and tap holes for the coaxial connections to be used for the amplifier input. Drill a new hole in a location near the output RF connector; this is where we will install a new DC power feedthrough capacitor. After all drilling operations and cleanup are complete, remount the original PC board to the metal assemble, using grounded static-free procedures. This will insure that you will not subject the PC board and its sensitive FETs to destructive static charges.

Before attaching the input coaxial connector, cut the input trace and add a 10-pF chip capacitor between the coaxial connector and the base of the first device. Mount the capacitor nearest to the coaxial connector, leaving as much of the input stripline lead as possible going to the input FET.

Next, connect the DC power lead to the feedthrough capacitor. It should be mounted near the output coaxial connector on the amplifier, if practical. The original LNA used a power feed option that provided DC power up the coax feedline. It is better to separate this line into separate DC power and RF output. Remove the connection for the DC power to the regulator input on the PC board from the coaxial connector. It's usually a small wire-wound RFC that connects to the output connector. Remove this lead and attach to the feedthrough. This operation is the same for both the LNA and the LNB.

If you are modifying an LNA, a separate mixer will be used. There are several choices for a suitable mixer, you could build one or purchase an excellent mixer for less than $20. The most reasonably priced mixer that I have come across is the SRA-11, which is good to 2,000 MHz and works well at 1691 MHz. It's a very small mixer about the size of a 14-pin IC. This mixer is starting to show up in modest quantities from surplus and that should hold down costs even further for construction of this converter. Coupling this external mixer and a small IF amplifier—for instance, an MMIC amp—completes the basic RF to IF circuitry, with the exception of the local oscillator.

Local Oscillator Circuit Ideas

Construction of a local oscillator is a task that can take many twists. There are several different PC boards available to get crystal-controlled circuitry going in the 500 or so MHz ranges. One of these types was developed for local oscillator injection use with the no-tune type of transceivers. This design was originally published in *QST* magazine. A variation of this circuitry is from the English publication, *RSGB*. Another variation would be to construct a VCO and synthesizer using the old favorite MC-145106 Motorola synthesizer chip with an appropriate frequency divider. All circuits require a frequency multiplier either to double or to triple the frequency of operation. The VCO model could be made to operate on the frequency needed for LO injection, but requires frequency dividers to allow the low-frequency synthesizer chip to be used. Of course, there are other circuits that can be used. These are just some starting ideas.

"In trying to give this project a fair shake, I must mention a few others and let you choose what is the easiest for you to obtain or construct."

In trying to give this project a fair shake, I must mention a few others and let you choose what is the easiest for you to obtain or construct. A suitable local oscillator can be obtained from a 10-GHz "Brick"-type, phased-lock oscillator, as most of the cavity-tuned oscillators run in the 1,600 to 2,000 MHz ranges and do not require conversion. Even a "Brick" with a defective diode multiplier can be put to use. The multiplier section originally multiplied the 1,600–2,000 MHz oscillator frequency by 6 to 10 times, to the 12-GHz range. For fundamental frequency operation of a "Brick"-type oscillator is not required. In this application, the high-power LO is phase locked to a crystal that is 1/16 or 1/17 of the high-power local oscillator.

Now what can be the cheapest local oscillator for this application? Well, again, the answer can

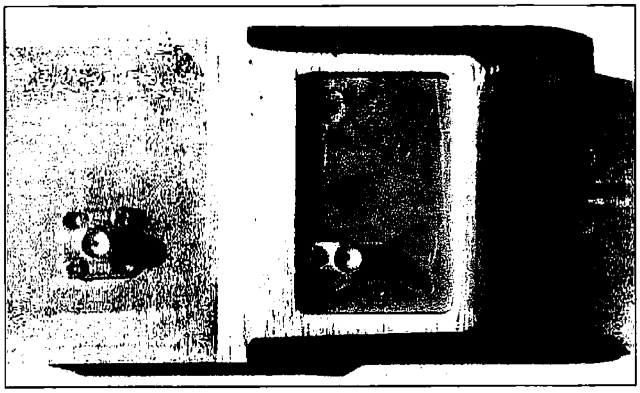


Photo C. Close-up of modified LNB, center connector LO, right connector RF input, left IF output.

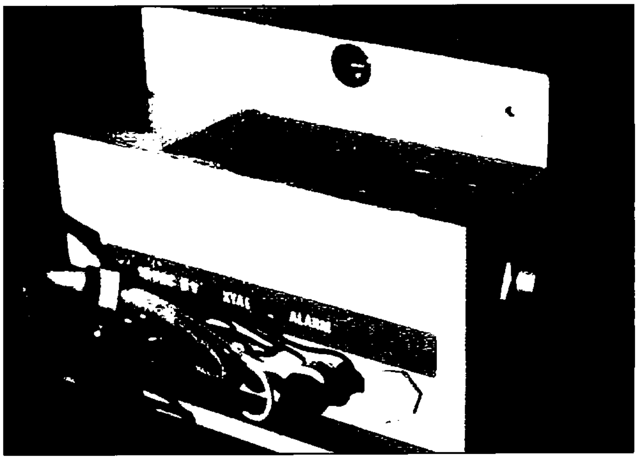


Photo D. Brick-type oscillator from Frequency West. Upper harmonic multiplier removed showing hole to which to connect probe for fundamental output. Hole is just above "M" in alarm notation on upper flat surface.

be found in the television marketplace in an unlikely component: a simple television tuner converter module. These tuners have a voltage-tuned oscillator that covers 500 MHz to over 1 GHz. They can be used with minimal circuitry to obtain the required injection frequency. Am I still on the kick of using a Motorola synthesizer chip (MC-145106)? You bet; it fills the bill well. The only problem with this circuit is that it provides 1/2 or 1/3 of the required local oscillator frequency. That necessitates the construction of a multiplier stage to double or triple the phase-locked synthesizer frequency. It should not be too tough to construct whatever type of oscillator you choose. Next month, some circuit ideas on the material we covered verbally. Be on the lookout for LNAs and LNBs for this conversion, which will continue next month.

Microwave Update 1995

The North Texas Microwave Society will hold the annual Microwave Update Convention in Arlington Texas on October 26, 27, 28, and 29, at the La Quinta Hotel. Reservations can be made by calling (800) 453-7909. The La Quinta is at 825 N. Watson Rd., Arlington, Texas 76011.

The technical program for Microwave Update 95 is nearly completed. The program consists of many well-known technical microwave enthusiasts from across the nation, and even Japan and England. There will be a wide range of topics that cover 902 MHz to 24 GHz. The customary noise-figure-measuring workshop will be held Friday evening along with the flea market. Test equipment demonstrations are planned by Hewlett Packard and Tektronix. We plan to have a network analyzer available for tuning filters, etc. Bring your LOs.

Kent WA5VJB will help out with the customary equipment auction, which is always helpful in offsetting conference expenses. Prize drawings will be held in between the technical papers, and again all donations are very much appreciated. Please contact WB5LUA if you have anything to offer.

"We are always looking for conference papers even if you do not wish to present them at a formal session."

As in past years the ARRL has again offered to publish the proceedings, and all information on the world above 902 MHz is very much appreciated. We are always looking for conference papers even if you do not wish to present them at a formal session. The articles can be any length, even one page. It is preferred that the papers be camera ready, and therefore best printed on a laser jet printer. The ARRL prefers 1-inch margins at the bottom and 3/4-inch margins on the other three sides. Photographs should be labeled but not attached to paper.

Conference pre-registration costs $40 and is due by October 2. Regular registration fee at the door and after October 2 is $45. Contact Al Ward WB5LUA, 2306 Forest Grove Estates Rd., Allen, Texas 75002, for information about this great convention, which centers on microwave activity and the dissemination of the latest information to the amateur community.

HAM TO HAM

Number 22 on your Feedback card

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles, IL 60714-3108

Beginning this month, *73 Amateur Radio Today* is inaugurating a totally new column, *Ham To Ham*, or HTH for short. We're looking for interesting ideas, tips, suggestions, simple equipment modifications, workshop techniques—whatever you think might be of interest or helpful to other hams, both those who are just starting out and we Old Timers alike.

HTH will be just that, a column of interesting ideas passed on from one ham to another. We'll need your help in designing both the actual format and the month-to-month contents of the column. I'll start if off, but whether it continues is up to you. Send in your favorite ideas, the things that perhaps you wish someone had told you before you were forced to find out the hard way, and we'll include them in this column.

To motivate and somewhat compensate you for your efforts, Uncle Wayne's unlimited budget for this effort will pay you $10 for every tip or suggestion that's published. No, you won't get rich, but it will help to defray your postage and writing costs; also, you'll have the satisfaction of knowing that you've helped a fellow ham and you'll get to see your name in print, a process perhaps making you famous, but not likely rich!

What kind of things are we looking for? You be the judge. Basically anything that seems like it might be helpful to others with the same rig or station accessory that you have. It might be an operational tip, a nifty modification (one that you know actually works well and is duplicatable), a novel way of doing something, or a circuit that you've found to be of benefit around your station. There are many new and exciting rigs and accessories out there today, and we're interested in your experiences and in the ways you found to improve some of them.

Just about any item ever designed has some bugs or inconveniences built into it. What have you discovered to make a particular piece of gear more "user friendly"? Send it to me and I'll try to include it in this column.

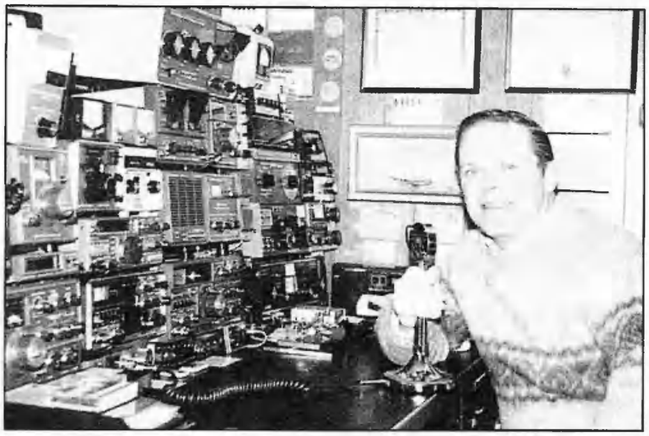
Anything around the ham shack is fair game here: transceivers, amplifiers, microphones, monitoring equipment, antennas, computers, computer peripherals, test equipment, clever shop tools, or new techniques on using tools—just about anything in the way of information that the rest of us will also find helpful. Try to keep it within the ham radio field, but even some ideas that may have universal appeal in our non-ham electronic lives will be considered. After all, we have to keep the XYL and harmonics happy, and they too may be potential hams in the rough.

When you send in your ideas, try to include as much detail as you possibly can. The more you can tell a person exactly how to implement your idea, the better chance of success they'll have to duplicate it. If a photo would help, include a clear, well-exposed one in color or B&W along with your idea. If a schematic or partial schematic would be invaluable, be sure to send a copy of one. If a mechanical drawing is called for, then a clearly marked, reasonably easy-to-read drawing would be very much appreciated by everyone who'll be using your idea. Even a sketch is better than nothing, if drawing isn't your strong suit.

By the way, we're definitely not looking for unsubstantiated complaints about any particular manufacturer's product. Try to be fair when writing about a particular brand of equipment. All electronic devices have faults or room for improvement. Even at that, what you may think is a problem someone else may see as a benefit. I suppose that the bottom line is: Err on the side of understanding rather than on the side of unjust criticism. We're a whole lot better off today than we were in the days when hams had to build just about everything they used around the shack.

So that's the basic game plan. Send your ideas, suggestions, tips, and techniques to me at: Ham To Ham, c/o Dave Miller, NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108

Please include a self-addressed, stamped return envelope if you would like to have any of your materials returned to you. Actually, I'd prefer that you send copies that you can spare, keeping the originals for your own files in case of questions or if further information is needed. Also, send only your original, unpublished ideas. If you're sending in an idea that a friend or club group originated, make sure that they have no objection to the idea being published and then use at least part of the 10 bucks to buy them all coffee & rolls.



New 73 columnist David F. Miller NZ9E, in the ham shack.

So show us the direction that you'd like to see this column take by sending me your best brainstorms. Uncle Wayne has given the go-ahead to give this idea a try, but we all have to work at it to make it work for us. Think of this column as a kind of "clearing house" for tips that all of us can use at some point or another. Uncle Wayne is providing us with the medium of the magazine to do that effectively. Above all, think of this as your column, a place where you can see your efforts in print so they'll be available to others in the hobby.

To show that my heart is in the right place, I'll give you a couple of my own ideas to get the ball rolling. These are just a couple of samples of what we're looking for in HTH; I hope that you or someone you know might find them useful. And don't be afraid to spread the word about HTH. The more ideas we have coming in, the more we can give back to the ham community.

A Source For Small Switch or Jack Boxes

Here's a tip I've used to obtain a small plastic box for mounting a miniature toggle switch or two, or perhaps a couple of miniature or sub-miniature phone jacks, and so forth in a hurry. Best of all, it's basically free!

If you own—or know someone who owns—one of those ultra-small pocket dictation tape recorders, the kind that use the "micro" cassette tapes, don't throw away the small plastic boxes that the blank tapes come in. These boxes measure about 2-1/4" x 1-1/2" x 1/2" and can be used to house the small switches & jacks mentioned above, plus many other miniature electronic do-dads very nicely. The boxes are insulated, have a built-in hinged lid, and are *free* with the microcassette tapes.

The box can be spruced up a bit with matching color of spray paint, if desired, and the ends are easily drilled and reamed to accommodate the incoming/outgoing cables plus miniature switches and jacks—along with other small parts such as resistors and capacitors—to complete whatever circuit you might be duplicating. A strip of double-faced tape will hold the finished box wherever you wish, on the side of a piece of equipment or perhaps under the lip of a shelf. It can be tucked away in any unobtrusive corner on the operating table, while providing both protection and easy access when needed.

Perhaps you'd like to bring out a remote input or output from the back of your transceiver, or maybe mount a small switch to control remotely one thing or another at the location of your choice, to fit your operating style. One of these little boxes can easily be recycled to accommodate the idea.

And the XYL wonders why I never throw anything away!

Better Visibility Tuning Indicators

Both the AEA PK-232 and the MFJ 1278B digital multi-mode controllers use red LED bargraph tuning indicators to assist the operator with correct transceiver tuning when operating on the HF bands. These red bargraphs are fine in subdued lighting, but they tend to "wash-out" under direct or overhead lighting, making the "dancing bars" difficult to see.

Fortunately, these bargraphs are made in convenient, 20-pin, plug-in, DIP packages, with 10 pins along each long edge and 5 LED vertical bars in each package. I've found that green bargraphs are much easier for me to see under high ambient lighting conditions, and since they are plug-in, it's an easy matter to change over to them if you've had the same experience. One source of these compatible green bargraphs is Digi-Key Corp., PO Box 677, Thief River Falls, MN 56701-0677 (Tel: 1-800-344-4539). They list the green arrays as their catalog part number LT1067-ND and also offer yellow ones as part number LT1068-ND.

Keep in mind that you'll also have to change the color of the "filter" plastic covering the rectangular cut-out in the front panel to match the color of the bargraph you've chosen. The filter material can simply be a small piece of colored plastic film available in many stationery or variety stores. The filter film isn't absolutely essential, but it does significantly improve the contrast ratio between the lighted LED and the background color-tone.

By the way, if when you plug-in the new LED array, it doesn't work the first time around, simply unplug it and rotate it 180 degrees. If you install it backwards, no harm will be done.

I'll be back with more Ham To Ham tips next month, and please remember to send in your ideas to the address shown above and we'll publish the better ones in this column each month, plus send you 10 bucks for your time and trouble!

73, DE Dave, NZ9E

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73* magazine, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* magazine for any equipment damage or malfunction resulting from information supplied in this column.

HAM HELP

Number 23 on your Feedback card

We are happy to provide Ham Help listings free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full (8 1/2" x 11") sheet of paper. Use upper- and lowercase letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Specifically mention that your message is for the Ham Help column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

WANTED: To borrow service manual/schematics for SINGER/GERTSCH FM10CS Station Monitor. *Marvin Moss, Box 28601, Atlanta GA 30358.*

WANTED: Manual for UNIDEN Bearcat Scanner BC 140 and information for modifications on this scanner. I will gladly pay for photocopies and postage. *Tom Waller, 311 Hillside Dr., Greenville AL 36037.*

I need an operating and/or technical manual for the REALISTIC PRO-2001 receiver. Anyone who can help please respond to *Daniel Anderson KB7PLO, P.O. Box 5306, Apache Jct. AZ 85278.* Or call *(602) 484-1037.*

NEEDED: Any information or schematics, etc., for an ATRONICS Code Reader (mfd. in Escondido CA). I will gladly pay for any costs incurred. *Len VE3INK, Toronto Ontario, Canada M9B 3W7. Tel. (416) 233-4998.*

I need a copy of a manual and/or schematic for a DENTRON MLA 2500 Linear Amplifier. I am willing to pay xerox and postage costs. Call collect first. *Edwin Barr K2HD, 3275 Lighthouse Way, Spring Hill FL 34607. Tel. (904) 686-7684.* Thanks for any help.

Regarding "FM Your IC-730," an article which appeared in the December 1985 issue of *73:* I need the parts placement corrections for the FM2 board. Can anyone help me? *Eugene Fischer W7IOR, (360) 293-6212.*

Never Say Die

Continued from page 4

chap from Illinois who was able to turn water into gasoline with a green powder. He demonstrated it for the skeptical reporter, who then proceded to run his car on it. Of course, that was 22 years ago and Harley is kicking himself for not following up on the idea.

The chap with the secret powder was cautious, and asking billions for the invention. He claimed that a Mr. Kraft had shown him the formula when he was 15. It was also shown to a friend of his, Anderson, who then went to the government and demonstrated it at the Brooklyn Navy Yard. Anderson disappeared the next day and has never been seen again.

Scientific Evidence

Do you personally have to see something to believe it? Supposing the same event is reported by several people around the world who have had no way to get together to concoct the story? Scientists have a problem believing in anything they can't reproduce on demand with 100% reliability, yet there are a wide variety of things going on that don't fit in with those restrictions.

While I've always had an interest in the occult, UFOs, and other anomalies, I've been put off by the close-mindedness of many people who reject the experiences of others. When something unusual happens, my instinct is to investigate it and try to understand what's going on, not to make every effort to reject or ignore it.

Scientists tend to sweep the unexplainable under the rug as "anomalies." For them that's enough of an explanation, and never mind trying to understand the anomaly or reproduce it. Doctors have the same mind-set, sweeping aside sudden cures for fatal illnesses as "spontaneous" cures. Thus, instead of trying to find out what brought about the "spontaneous" cure so it could be used to help others, they close their mental doors.

For centuries people have been having near death experiences (NDEs). There's a magnificent book by Dr. Crookall, *The Supreme Adventure*, published in 1961, which examines hundreds of NDE reports and shows how remarkably consistent they are. He then takes the next step and examines hundreds of reports of the "next world" as received through mediums. These, too, are quite consistent with the NDE reports. It's almost enough to make a person think.

I've read three recent books you might want to look for. There's Dannion Brinkley's *Saved By The Light* (1995; 204p), where he's struck by lightning and has quite an NDE. It's worth the $6. Unlike most other visitors to "heaven," this chap was given some glimpses into the future. If you've been keeping up with the latest in technology, you'll find his piece on the coming development of DNA-type computer systems most prescient for a 1975 NDE experience.

Then there's Mally Cox-Chapman's *The Case For Heaven* (Putnam 1995; 203p; $30). She tells in detail about her own experience, and then the stories of dozens of more people she's interviewed who've had similar experiences. Having gradually become an old man, and thus perhaps a little more concerned with death, these "light" books are of increasing interest to me.

There's also Betty Eadie's *Embraced By The Light* (1994; 145p; $6). You should be able to whip through it in less than an hour. She puts more of a religious interpretation on heaven than most others who've been through the experience, but her story is quite similar to all the others in most respects.

Another NDE resource is Cherie Sutherland's *Reborn In The Light* (1995; 303p; $6). Like the others, she reports on a number of people she's interviewed. Their stories are similar. There is the pattern after the NDE of no longer fearing death, but looking forward to it. Most come into contact with a Supreme Being who radiates love. Most are told they have tasks to do on earth before going to heaven and so must return until it is their time. While most of them become more religious, few continue going to organized churches. They come back with the message that God isn't interested in theology. Most of them, while dead, undergo a life review where they experience what they felt and what the other people around them felt as a result of their actions. I have an ex-wife who's going to have a major problem with that, and not a few ex-employees.

Of course I can't help, while reading about these NDEs, looking back at my life to see how I might have done better. My total lack of interest in money has been a hardship for my wife, who is much more money oriented. It's also been a magnet for those who would take

advantage of my lack of interest and who have robbed me of millions. But, having (at least in my eyes) helped the world along with the development of cellular telephones, microcomputers, compact discs (better music), my record companies, and now (hopefully) cold fusion, I feel my visit to earth has been worthwhile.

My love of amateur radio has been guiding me for most of my life. Sure, I get frustrated when I hear hams using bad language and being inconsiderate on the air. I almost got angry when the ARRL virtually destroyed the hobby 30 years ago in their move to generate greater visibility for the League with their so-called "incentive licensing." And my ability to forgive, forget, and love my enemies is sorely strained when people print lies and distortions about me.

Another, slightly older book on NDEs is Dr. Moody's *The Light Beyond,* (1988; 205p; $4.50). He even interviewed a number of children who'd had NDEs, with their stories all being quite consistent.

The reports are that a whole realm of the afterlife is set aside for the pursuit of knowledge. Well, I've got a good start in that direction. When I die, it's going to take a trailer truck to bring my library, and I'm not going anywhere permanent without it. If I can't take my books and music, I'm not going.

Closer To The Light by Dr. Morse (1990; 237p; $6) deals with children's NDEs. What does it feel like for them when they die? What do they learn? We're going to have to understand more about how time works because many NDE reports have to do with future events. You'll also enjoy Brad Steiger's *One with the Light* (1994; 300p; $5), which not only covers a wide variety of NDE reports, but shows how in every case the experience has substantially changed the people's lives.

If you've read very many biographies, you know that many (most?) of our creative artists attribute much of their inspiration to the ineffable. Sousa said that all of his marches came to him when he was in a half-sleep state. They came full blown, so all he had to do was get up and write them down. Many composers and writers tell similar stories. In *Neither Dead Nor Sleeping,* May Sewall (Bobbs-Merrill, 1920; 320p; $2.50 in an old book store) wrote that her deceased husband explained to her that spirits on "the other side" are responsible for these subconscious creative events.

There's a current spate of books about guardian angels. The recent TV programs on angels probably triggered this interest. In between reading Peter Graneau's *Ampere-Neumann Electrodynamics of Metals,* I'll whip through Hope Price's *Angels,* a $5 Avon inspirational pocket book that reports on hundreds of angel interventions. There are a bunch more angel books, all packed with stories of people who've been touched by them. Now, are you going to try to tell me that every single one of these people are totally mistaken? Give me a break!

No, I can't see auras or bend spoons, but I have no good reason to disbelieve the many people I know who claim to have done these things. There are a great many things going on for which we have no good scientific explanation. Can you assure me that not one person in history has ever been able to dowse? My grandfather, who was an inventor, taught me how to dowse (to use a divining rode to find underground water or minerals). "Pop" was good at it. He also was a good inventor. You wouldn't see Citgo or Continental Can Company around today except for him. He knew a lot about everything, so I accepted dowsing and had no trouble learning how to do it when I was about seven. Alas, he was a heavy smoker, so he died when I was only 12. My grandmother, who didn't smoke, lived on almost 30 years longer. I'll have to tell you more about her some time. She put me onto the Sewall book 3 years after she died.

Though I haven't had a near-death experience, I still have a pretty good idea of what my mission in this life is. It's what I've been doing for the last 44 years as a publisher: sharing the things I've found fun and exciting with you, and urging you to share with me. So I'm on your case, urging you to do better. To lose weight and thus live a longer and happier life. To not smoke. And to be adventurous. To try new things. To go new places. To try packet. To try satellite communications. To try going on a DXpedition somewhere. To learn more. To read.

If your reaction is negative, remember that this could be an approach to life that you carry around with you. Life is more what you make it than it is a box of chocolates. If you're nasty, so will be the

people around you. If you get on the air to have fun and meet new people, that's what you'll find, for the most part. When you run into an ill-mannered op, try another frequency instead of getting mad or getting even.

One thing both the angel and the NDE reports all agree on is that prayer can be surprisingly powerful. It doesn't seem to matter what deities you believe in; just the act of praying has power to heal and change things. No, this is not a new concept and it doesn't mean that poor, old, aging Wayne is newly converted to any particular savior. I'm just telling you what thousands of people I've read about have reported.

As I'm writing this, I'm thoroughly enjoying a CD of Louis Moreau Gottschalk's (1829-1869) music. His music was sort of a precursor of ragtime, and he was the first internationally famous American composer. Though it's difficult for me to imagine, I suppose there are some people who might not find his music irresistible. His *Tarantella, Rèsponds Moi, Ojos Criollos, Orfa, La Gallina, Bamboula, Grand Fantasia,* and *Pasquinade* are incredible. If I can't get you to enjoy reading books and learning, maybe I can turn you on to some wonderful music? No, all you want me to write about is ham radio, right?

So what do you find the most exciting about amateur radio? What adventures have you had? If you've made even a tenth the number of friends via the hobby that I have, it's paid off for you handsomely. That's probably what brings me back to Dayton every year most of all. When's the last time you had a contact where you talked with someone for over an hour and you both hated to end it? I used to offer a certificate for long-winded contacts: the Real Rag Chewer's Club certificate (RRCC) for contacts over an hour. Let me know if I should offer that again.

Of course,I used to offer a WAAS (Worked Almost All States) certificate for hams who'd worked 49 states. Then there was my CHC (Certificate Hater's Club) for hams who hate certificates and promise not to go after them; and if they do by chance get one, they promise to hate it.

Maybe it's best I don't write about amateur radio and just stick to my secret goals of trying to get you to have more fun, to learn, and to shape up.

Leasing The Spectrum

The FCC's recent spectrum fire sale brought in $10 billion . . . just for a few more cellular phone channels. Not bad, considering the FCC's annual $200 million budget. I know you aren't going to believe this, but Congress has noticed this new revenue source.

The estimated value of the commercially used spectrum, according to Peter Huber in Forbes, is at least $200 billion. And that doesn't count the frequencies some projected new services are going to need. Leasing the currently used spectrum could therefore be expected to provide at least an extra $20 billion a year for Congress either to reduce the national debt or to invest in bigger and better pork. Guess which way I think they'll elect to go?

So what is going to happen now that Congress has found that there is a megadollar value to those microwave megahertz we haven't been bothering to use? Yes, I know—who cares as long as they leave 20m and 75m alone, right? It wasn't very long ago that*CQ* Magazine proposed that the 146-148 MHz band be taken away from us and turned into a new CB band. Have you thanked them for that yet? That was just before repeaters got popular. Up until then the top two megahertz of 2m was almost unused. If we lose two or three microwave (satellite) bands, that could end our potential for developing a worldwide ham net similar to the Internet.

Hmm, seems to me I've written most of this before. Often. Anyone awake out there?

A Great Role Model

John Abbott K6YB has been getting some superb publicity for amateur radio in the L.A. Times. Bravo. That's what we need. John has been teaching youngsters about radio as a volunteer for 5 years. Carole Perry had a nice piece about his work in her December 1993 "Hams with Class" column. And Gordon West reviewed John's *Riding's The Airwaves with Alpha and Zulu* in *Radio Fun.*

How about you? Could you spare some time once or twice a week to visit a local school to teach some 9-11 year olds about amateur radio?

Auto-Ident?

A letter from Ernest N7ULU of Phoenix suggests that our rigs might have a built-in chip that would automatically identify our station in code when the mike button is pushed. It's been some time since I've written about that, but for some reason no one seems to have picked up the ball.

If the call is sent at around 20 wpm, it would only require a 3-second wait before talking. This might present a problem for over-excited talkers, but most of us would soon learn to adapt to it. I'd also suggest a timer be built in which would prevent the identification from being sent more than once every 5 minutes. It could also be programmed to butt in and identify every 10 minutes if the transmitting operator happens to be as long winded as I.

Instead of keying the transmitter on and off, it could send the call with a tone (MCW). This would make it so you could talk over it if you just couldn't wait 3 seconds.

This would make it possible to save a good deal of time spent in oral identification. The fact is that I'm quite familiar with my own call, so it gets a bit tedious to hear the chap I'm in contact with repeating it at the beginning and end of every transmission. Yes, I know we've been doing this ritual ever since hamming started. But that doesn't make it any more sensible.

> ***"Could you spare some time once or twice a week to visit a local school to teach some 9–11 year olds about amateur radio?"***

Of course, what I would much prefer is some work done on achieving what we should have done 50 years ago: duplex contacts. This one-way simplex business is right out of the smoke-signal age. When will I start hearing the ARRL petitioning the FCC for a return of spark? Maybe narrowband spark, for better spectrum efficiency.

The War On Poverty

The recent PBS series on President Johnson's futile war on poverty made it pretty clear that throwing money at the problem hasn't worked. Most of the thrown money ends up in the hands of the government bureaucrats. That reminds me of the quote about the missionaries going to Hawaii to do good, and doing very well indeed. America's "war on poverty" has cost taxpayers trillions of dollars, and helped build an even larger federal bureaucracy which has made the poverty situation worse.

Maybe there *is* no solution to the poverty problem. Maybe there will always be poor people. Yes, there probably always will, but there don't have to be as many of them. Not nearly as many. So what's happening that's generating generation after generation of poor people, and what can be done to break the insidious pattern?

You may at first think I'm really stretching to claim that amateur radio can be a big part of the solution. So how can I make the claim that amateur radio can be instrumental in helping eliminate much of the poverty in America (or anywhere else in the world, for that matter)?

Let's start with fundamentals. If you've given any thought to the poverty problem, you've certainly noticed that there are very few really poor people with good educations. Oh, I know a couple, but they are certified nut cases and are thus unable to work despite their education. As a good general rule let's agree that education and poverty don't go together. You may also have noticed that very few rich people are uneducated. This is not a coincidence.

Okay, if we want to get rid of poverty we're going to have to somehow see that poor kids get educated. And this isn't going to be easy. I won't go into the gory details, but we're saddled with one of the worst government-run school systems in the world, plus parents who are busy teaching their children how to stay poor, and peer pressure (gangs) pushing them to drop out of school.

Immigrant Asian parents, who emphasize the importance of education to their children, prove that the parents can have a powerful impact on their kids. Though often poor, they see to it that their children get a good education and move out of poverty, despite our terrible school system.

There are some practical solutions to improving our schools and to generating an Interest in poor parents to encourage their children to be educated. I've covered this territory in some depth in my *Declare War* book and its updates, so I won't repeat all that.

Where Does Amateur Radio Fit In?

It's a high-tech world. Our kids have to cope with the information superhighway, and that means computer literacy, a need to understand electronics, television, and so on. A generation ago we used typewriters, today it's word processors. It wasn't very long ago that we used pens, blotters and pen wipers. There aren't very many blotter manufacturers any more. If any.

Just as there is a strong parallel between education and success in life, in today's world there is also a parallel between high-tech and success. Scientists, engineers, and technicians are being more and more needed to fuel the changes in our society. Communications and transportation are speeding up and

getting cheaper. This is putting every worker in America on a more level playing field with workers around the world. If your job can be done as well or better by a foreign worker at a lower cost, you're going to lose out. Job protection can't be legislated. One's job protection is one's accumulation of skills and knowledge.

Here comes amateur radio.

As a scientific hobby, amateur radio has the potential for interesting youngsters in learning about electronics and communications. Even computers are an integral part of hamming these days. One of the big keys to making our American school system more effective is to make it more fun to learn. Hamming, where we have a group of around 73 hobbies, has almost unlimited fun for youngsters. It is a key to getting them to learn because they want to, not because the government will punish them if they don't go to school.

Back in the 1950s, before our only national amateur radio organization, the ARRL and their so-called "Incentive Licensing" proposal to the FCC, destroyed both the ham industry and the infrastructure which was feeding youngsters into the hobby, studies showed that 80% of all new licensees were youngsters and that 80% of those went on to high-tech careers as a result. That's what happened to me.

Indeed, amateur radio was the major supplier of scientists, engineers and technicians for our country. When World War II came along 80% of our hams enlisted. As did I. When I went to the Navy electronics school I found hams everywhere. Virtually all the instructors were hams. Later, when I went into ham publishing, I found that a high percentage of the top people in the electronics and communications industries were hams who had, like me, started in their teens. In the 1950s 50% of all new hams were 14 or 15 years old!

In those days virtually every high school had a ham radio club. That's what got me going. I went to Erasmus Hall High School in Brooklyn (NY). My interest in building radios and listening to the short waves got me to join the club. From there on the club members got me to practice the code and get my ham license. These clubs were almost all wiped out by ARRL's Incentive Licensing mess 30 years ago. That's when the hobby stopped growing, going from 11% growth per year (for 18 years) to less than 1% most years since then. That's when every major ham equipment manufacturer and 85% of the ham dealers went out of business.

Packet radio is an exciting aspect of the hobby. It gets kids to learn about computers and digital communications because they want to. Slow- and fast-scan television teaches them about video and digital data compression. Ham satellite communications helps them learn to deal with microwaves. And all of this is real fun!

I've been urging every ham radio club in America to get busy and get radio clubs restarted in our schools so we can regain our lost amateur radio infrastructure. Today we need to get kids interested in high-tech when they are 8-10 years old. This is why I've proposed that we start teaching the fundamentals of electronics in every school in grades 5-12. There is less and less need in business for people who are ignorant of technology. Almost everyone has to deal with computers and communications in their work, so the more they understand what they are doing, the more valuable they are going to be. The man or woman who looks up helplessly when his or her computer stops working will be replaced by a more self-sufficient worker.

We're heading into a world of video conferencing, telemarketing, and information handling. Good jobs await those with the skills and knowledge to deal with this world. Poverty awaits those who don't keep up.

Amateur radio is by far the best hobby there is for getting youngsters interested in learning the things which will be more help to them later on. There are a bunch of other scientific hobbies, but none of them have such a wide variety of interests and excitement to offer.

We have DXers, who are mainly interested in contacting foreign countries. We have specialists who love contests, who want to see how many countries they can contact on some particular ham band, such as 160 or 80 meters. We have awards for contacting all states, and so on, which can be very difficult on some ham bands. We have weirdoes (like me) who love to visit countries which haven't many active hams and get on the air for a few days, making thousands of short contacts and providing DXers with a confirmation of a new country contacted.

Most hams get interested in building their own equipment. Some buy kits and assemble them. Others buy the basic parts and build. At the Dayton hamfest every year there are acres of hams selling equipment and parts at the flea market.

There are over 500 such exhibits. And parts are being sold at every hamfest and convention around the country. It's fun to build and get something new to work.

Unless we in America use every stratagem to get our kids to build their skills and high-tech knowledge, youngsters in other countries are going to take away their jobs. Just look at the way Asian countries such as Japan, Taiwan, Hong Kong, Singapore, Thailand, Malaysia, and India have been pulling themselves from incredible poverty to wealth. I've been visiting these countries for over 35 years now and I have seen the unbelievable changes first hand. In Japan, there are more than twice as many ham radio operators per capita as we have. Every school in Japan has a radio club. Is it any wonder they've been able to take away every consumer electronics industry of ours?

We invented the transistor, they developed and marketed it. We invented video tape, they developed and marketed it. And so on. We don't make TV sets any more. We don't make cassette recorders or VCRs. Japan makes about 90% of our audio equipment. When I visit their factories in Japan I am met by Japanese hams at every turn.

What can you do about all this? That's easy, start helping your local schools to form radio clubs and get kids interested in amateur radio. It'll be the best thing you can do for the kids, for America, and for yourself. Yes, the school administrators will probably fight you at every turn. Try my motto: Never Say Die! Get on your local school board and keep the pressure on. We need tens of thousands of school radio clubs and millions of new hams. Maybe tens of millions. We have more than enough frequencies available. Heck, we're using less than 3% of our ham bands today.

What are you doing just sitting there? Why aren't you on the phone calling your local schools to arrange to talk with the 8–10 year old kids about hamming?

Amateur radio, properly applied, has the potential to do more for anti-poverty than all of the enormously wasteful government programs. in the long run we'll have a far more stable society when we have as few people in poverty as possible. The extremes of wealth and the lack of it feed discontent, as we see our politicians using to their advantage at every turn. The more we can build up our middle class and eliminate our poor and rich, the less jealousy and envy we'll have dividing us. But it's up to us to do something, not our politicians or bureaucrats, who are in bed together.

The millions of bureaucrats kept in business by anti-poverty programs and welfare have a powerful vested interest in maintaining poverty and welfare. Why on earth should a welfare worker do anything which is going to get people off of welfare? That's shooting themselves in the foot. In the long run your choice is to let things go along as they have, sending a large part of your earnings to the government to distribute, or to start your own private war against the status quo by striking sparks to enlighten the minds of our kids.

I can do no more than give you the tools and point out a worthy goal. I can't come to your home and yank you off your sofa, away from that ball game, or from your ham rig where you are probably adding to a pileup trying to get a 15-second contact with some guy in a rare country. Or checking into a net for the benefit of no one whatever. Our kids need your help. And so does our country. And so does amateur radio.

Yes, I mentioned my book, *We The People Declare War On Our Lousy Government.* Do you read books? I review interesting books I've read in my *73* editorials. In my book I provide proposals for simple, inexpensive ways to help solve our more serious social problems. Like our terrible school system. Our unhealthy so-called health care system. Crime, drugs, foreign aid, and stuff like that.

At Dayton this year there was a parade of hundreds of *73* readers coming by my booth to say how much they enjoy my editorials. Many claimed that I've changed their lives. So I'll keep writing . . . about amateur radio and the fun it can provide . . . about how we can use this to help the whole world. And about anything else I find fun and thus want to share with you.

Next Month?

After several pages of small type I'll bet you think I've run out of things to write about. No way. Next month I'll get into some books I've read recently on how to stay totally healthy and live to be a hundred or more. Will I be able to change your whole life around, making it so you'll never have to worry about cancer, heart by-pass operations, Alzheimer's, and so on? Only if you pay attention to Uncle Wayne.

PROPAGATION

Number 24 on your Feedback card

Dennis Kopecky WJ2R

Dennis Kopecky WJ2R
P.O. Box 875
Rahway, NJ 07065

Conditions This Month

This month has the appearance of being one of the best months for HF communication in the past several months. Fall conditions prevail and the only really POOR days forecast are expected to be the 12th, 13th, 30th, and 31st. The calendar shows that very GOOD days are extended from the 15th through the 29th, with only a few of those days (15, 21-23, 28-29 trending to Fair). Remember, though, that Cycle 22 is drawing to a close and that most HF bands will soon be at their lowest ebb. Make the most of this month with your finest operating skills!

Weather-wise, the 12th and 13th and the 30th and 31st may produce storms and/or other geophysical upsets. Be prepared a day or two either way.

10 and 12 Meters

Not expected to be very good, but still should be monitored for transequatorial/tropical paths during the daylight hours.

15 and 17 Meters

Similar in overall outlook as 10 and 12 Meters, but with better chances to work DX because of the outright popularity of these bands throughout our worldwide community.

20 Meters

This is your workhorse band for worldwide DX during the daylight hours this month, with occasional openings beyond local time sunset, moving from east to west, and long skip north and south.

40 Meters

DX on this band should be available from just before sunset until just after sunrise, which also means broadcast station interference in the phone portion of the band. Concentrate on the days marked fair or even poor, as conditions on the higher bands (which should still be checked) may make them unusable.

80 and 160 Meters

Expect some fairly good DX and short-skip openings during the hours of darkness, which will be lengthening the time we will be able to pursue our pastime!

VLF (160–190 kcs.)

Anyone with interesting happenings in this portion of the spectrum is invited to contact me. I'd like to receive data regarding conditions over a period of time—that is, fair, improving to very good over a period of days, and vice versa, with signal levels, distances worked, time of day, etc. (the usual stuff! TNX).

OCTOBER 1995

SUN	MON	TUE	WED	THU	FRI	SAT
1 F	2 F-G	3 F-G	4 F-G	5 G-F	6 F	7 F-P
8 F	9 F-G	10 G-F	11 F-P	12 P	13 P	14 P-F
15 F-G	16 P	17 F	18 F	19 G	20 G	21 G-F
22 F	23 F-G	24 G	25 G	26 G	27 G	28 G-F
29 F-P	30 P	31 P				

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

Number 26 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

OCT 21

GRANDVIEW, MO The Southside ARC will hold their "Octoberfest" at Grandview East Jr. H.S., 12650 Manchester. VE Exams. Talk-in on 147.120. Contact *KG0UP, P.O. Box 1142, Grandview MO 64030.*

GRAY, TN The 15th annual Tri-Cities Hamfest will be held at the Appalachian Fair Grounds, located off I-181 in Gray TN. Drive-in Indoor/Outdoor Flea Market. Mail inquiries to *Tri-Cities Hamfest, P.O. Box 3682 CRS, Johnson City TN 37602.* Sponsored by the Kingsport, Bristol, and Johnson City Radio Clubs.

HOLLAND, MI The Holland ARC will host a Hamfest at Holland Christian H.S., 950 Ottawa Ave., 8 AM-1 PM. VE Exams. Talk-in on 147.060(+) pi 94.8. Contact *Barbara Siebelink N8NXA, 6418 Otis Rd., Saugatuck MI 49453. Tel. (616) 857-1343,* or Fax *(616) 857-1463.*

MEDFORD, OR The Rogue Valley ARC will hold a Swapmeet at the Medford Armory, 1701 South Pacific Hwy., 9 AM-4 PM. Setup at 7 AM. Computers. Radio Gear. VE Exams, pre-reg. and walk-in; contact *Paul Miller KE7VO, Box 555, Shady Cove OR 97539. Tel. (503) 878-3433.* Make check payable to *RVARC, 1707 East Main St., Medford OR 97504.* Your name tag and entry tickets will be at the entrance door. South of Medford, talk-in on 147.160 Rptr. North of Medford, talk-in on 146.940 Rptr.

SALEM, OR The Mid-Valley ARES will present the 1995 "Swap-toberfest" and ARES/RACES Convention at the Polk County Fairgrounds in Rickreal OR. Time: 9 AM-4 PM. Swap table setup 6 PM-9 PM Fri., Oct. 20th, and 7 AM Sat. Talk-in on the 146.86 Rptr. Flea Market. Dealers. VE Exams, pre-reg. required; contact *Sandy Berry N7TQQ, (503) 588-7685.* To reserve swap tables, contact *Evan Burroughs N7IFJ, (503) 585-5924.* Commercial and Specialty Dealers, call *Garry Zinn KC7BSX, (503) 378-3702.*

SENECA, PA The Ft. Venango Mike & Key Club Ham Radio Auction and Flea Market will be held at the Christian Life Building, Rte. 257 between Rte. 322 and Rte. 62. All activities will be held in the gymnasium and cafeteria. Auction items are cash only! Doors open at 8 AM; the auction begins at 10 AM. Talk-in on 147.12(+), 145.23(-), 145.19(-) and 444.125(+). To reserve Flea Market space, call *Mary Housholder N3QCR, (814) 437-2036; e-mail address: MAHOUSHOLD@AOL.COM;* or write to *Fort Venango Mike & Key Club, R.D. #1, P.O. Box 591, Cranberry PA 16319.*

SUMTER, SC The Sumter ARA Hamfest/Computer Fair will be held 8 AM-4 PM at the Sumter County Exhibition Center, 700 W. Liberty St. Dealer and Flea Market setup Fri., 4 PM-9 PM; Sat., 6 AM. VE Exams will begin at approx. 10 AM, walk-ins only. Call for more info. Talk-in on 147.015(+). Dealers call *Tommy Dubose KB4CIH, (803) 469-5093.* For Flea Market tables, camping/tailgating and general info., call *Mike Dunlap KC4HUT, (803) 481-4611.*

OCT 21-22

WEST PALM BEACH, FL The Palm Beach Rptr. Assn, Inc. will host the Palm Beach County Hamfest Amateur Radio/Computer Show at the South Florida Fairgrounds, Southern Blvd., in West Palm Beach. Gates open Sat., 9 AM-5 PM; Sun., 9 AM-3 PM. VE Exams both days, on site, at 9 AM. Vendors, call *Hal Gainen, (407) 439-0805.* To reserve Flea Market tables, call *Vi Kiekenapp, (407) 585-9074.* Full RV hookup - *1-800-527-3247.* Talk-in on 147.165/.765.

OCT 22

SELLERSVILLE, PA The RH Hill ARC will hold a Hamfest at Sellersville Fire House, Rte. 152, 5 miles South of Quakertown and 8 mi. North of Montgomeryville. Talk-in on 145.31. VE Exams start at 9 AM, all classes. Bring documents. Contact *Linda Erdman KA3TJZ, P.O. Box 29, Colmar PA 18915. Tel. (215) 679-5764.*

WARREN, MI The Utica Shelby Emergency Comm. Assn., Inc. will hold their "USECA Swap" at Our Lady of Redemption Conference Center, 425 Cole, in Warren. Ham gear, electronics, computers, software. VE Exams, pre-reg. required; call *Bill N8CVC, (810) 468-8345.* Non-ham gift items will also be featured. Contact *Chairman Kevin Everett N8QVX, 21947 Birchwood, Eastpoint MI 48021; Tel. (810) 772-8082;* or call *Jim N8OKW or Marianne N8TMJ, (810) 739-6565;* or *Biff N8NQQ, (810) 566-7743.* Talk-in on 147.18(+) (100 Hz tone), and 147.42 simplex.

OCT 28

CONNECTICUT The annual Ham Radio Auction sponsored by Tri City ARC will be held at the Senior Citizens Center, Waterford Municipal Complex, from 10 AM until sold out. Bring your equipment to be auctioned. Talk-in on 146.37/.97 Rptr. For info call *KA1BB at (203) 739-8016.*

PORT ST. LUCIE, FL Port St. Lucie ARA will present "Hamfest-95" 0800-1500 hours at the Port St. Lucie Yacht Club, 500 Prima Vista Blvd. Talk-in on 146.955/R; alternate 146.520 simplex. For details, call *Bill Perciasepe, (407) 879-4020;* or *Roy Cox, (407) 340-4319.*

ST. LOUIS, MO The 4th annual Halloween Hamfest, sponsored by the Gateway to Ham Radio Club and the St. Louis ARC, will be held from 8:30 AM-2 PM at West County Technical H.S., Hwy. 40/I-64 and Maryville Centre Dr., 8 mi. W of St. Louis. Talk-in on 147.34/.94. Commercial vendors, forums, VE Exams. For info on tables, tickets, call or write *Keith Ray N0KFE, 4642 Ray Ave., St. Louis MO 63116; Tel. (314) 832-8895.*

ST PAUL, MN The 11th Hamfest Minnesota and Computer Expo, sponsored by the Twin Cities FM Club, will be held 8 AM-4 PM in the main arena at the St. Paul Civic Center, Kellogg and West 7th St. Flea Market, educational and fun seminars, and more. VE Exams administered Fri. at 6 PM by St. Paul Radio Club VE Team. Flea Market setup Fri. night. For info and advance reg. call *(612) 535-0637;* or write *P.O. Box 5598, Hopkins MN 55343.* Talk-in on 146.16/.76 Rptr.

OCT 29

DES MOINES, IA "Hamfest Iowa '95" will be sponsored by the Tikva Tracers ARC in the 4H Building at Iowa State Fairgrounds. Setup Sat., 6 PM-9 PM; Sun., 6 AM. VE Exams at 9:30 AM. Talk-in on 146.22/.82. Contact *Randal Lees N0LMS, 1575 Northwest 78th St., Clive IA 50325-1255. Tel. (515) 279-4241.*

LINDENHURST, NY The Suffolk County RC and The Great South Bay RC will hold their AARL approved Long Island Hamfest/Computer Show 9 AM-4 PM at the Knights of Columbus Hall, 400 South Broadway. Talk-in on WB2FKZ Rptr., 146.685 (pl 4Z - 136.5 Hz) and 223.86 (Open Carrier). Call for info 7 PM-10 PM, *Andy Feldman WB2FXN, (516) 928-3868;* or *Walt Wenzel KA2RGI, (516) 957-0218.*

NEWTOWN, PA The Penn Wireless Assn. Ham/Computer Tradefest will be held 8 AM-4 PM at Bucks County Comm. College, next to Tyler State Park, on Swamp Rd. VE Exams 10 AM; call *(215) 943-4886.* Talk-in on 145.250 pl 131.8, or 146.520 simplex. For details, call *Steve, (215) 752-1202.*

SOUTHWICK, MA The Hampden County Radio Assn. will present its annual Hamfest/Electronics Show at the Soutwick Rec. Center, Powder Mill Rd., just off Rte. 57. Setup at 6 AM. Open to the public at 9 AM. VE Exams, pre-reg. required; contact *Yorke Phillips K1BXE, (413) 566-3010.* For reservations and info, contact *Barry Mason N1IJK, (413) 747-7010 before 10 PM;* or *John Walker N1QXV, (413) 572-4592 before 9 PM.* Or write to *Hamfest Committee, 36 Kenwood Terrace, Springfield MA 01108-1716.*

WESTMINSTER, MD The 6th annual Mason-Dixon Computer/Hamfest will be co-sponsored by the Carroll County and Penn-Mar ARCs., at the Carroll County Ag Center. Seminars will be presented. 6 AM Vendor and Tailgating; 8 AM General Admission. VE Exam reg. begins at 8 AM; pre-reg. requested. Call *Bill Wolfgang NZ3J, (717) 359-7095.* Talk-in on 145.41 MHz. For general info, contact *Larry Martin N3DGK, (410) 374-4544.*

SPECIAL EVENT STATIONS

OCT 7-8

LAKE STEVENS, WA and WICHITA FALLS, TX The 5th annual Missionfest will be on the air, seeking to talk wilh and encourage Christian missionaries throughout the world. Co-sponsored by Christ Lutheran of Wichita Falls TX, and Elim Lutheran of Lake Stevens WA, HF operations will be from 1500 UTC-0600 UTC Sat., and again from 1900 UTC-0100 UTC on Sun. Freq.: 28.420, 21.420, 14.278 and 7.278 MHz. Join in with prayer requests, and visit with foreign missionaries worldwide! Callsigns N5JRF (Wichita Falls), and N5UJA (Lake Stevens). Call *(206) 334-2540* for more info.

PITTSBURG, PA The Breezeshooters ARC will operate W3XX from the submarine USS Requin, 1400Z-2100Z Oct. 7-8, to celebrate the Centennial of the Carnegie Science Center. The Requin is docked at the Carnegie Science Center. Operation will be on vintage CW equip., in the lower half of the Novice subbands. Phone operation will be in the General class segment of 20m and 40m. For a certificate and QSL card, send QSL and an 8 1/2" x 11" SASE to *Ron Berry WB3LHD, 326 Sunset Dr., Bethel Park PA 15102.*

OCT 11-15

CINCINNATI, OH Radio amateurs in the tri-state area around Cincinnati will operate SE Stations using /TS suffix, as part of the 1995 Tall Stacks celebration. Sponsoring club calls will be K8SCH/TS (OH-KY-IN ARS), W8DZ/TS (Greater Cincinnati ARA), and W8VND/TS (Queen City Emergency Net). They will operate all bands and modes thru 70 cm. Special QSLs will be available to the callbook addresses; or N8FU SASE, or via bureau lor any or all of the special calls. Tall Stacks recalls the historic and continuing importance of river commerce, and will include 19 steam boats. Sponsored by the Greater Cincinnati Convention and Visitors Bureau.

OCT 13-15

WISCONSIN To commemorate its 4th annual disaster-services seminar, SATERN (Salvation Army Team Emergency Radio Network) will sponsor Station WW9E. CW and SSB activities are planned for the lower portions of the General and Novice subbands. Digital activities are also planned. For QSL, please send your card, SASE, and the name of the operator worked to *NH2Z, Apt. #608, 84-265 Farrington Hwy, Waianae HI 96792;* or directly to the operator contacted.

OCT 14

PENSACOLA, FL KF4BHC, The Serious Hams ARC, will put IOTA NA-142 from Fort Pickens in Santa Rosa Island, on the air 1230Z-1800Z. For QSL, send SASE to *Mike Brown N4MAD, 519 S. Edgewood Cir., Pensacola FL 32506.*

OCT 14-15

RICHMOND, CA The East Bay ARC will observe the 90th Birthday of the City of Richmond by operating W6CUS from club headquarters at the Richmond Red Cross building. Times: Oct. 14th, 0100-0500 and 1700-2400 UTC; Oct. 15th, 0000-0400 and 1700-2400 UTC. General subbands on 80, 40, 20, and 15m; Novice subbands on 10m and 2m. For a certificate, send QSL and a 9" x 12" SASE to *EBARC, P.O. Box 1393, El Cerrito CA 94530.*

OCT 21

CONCORDIA, KS The Kansas-Nebraska ARC will operate Station W0IND to commemorate the 50th Anniversary of the closing of the German Prisoner of War camp near Concordia. The station will operate 1400 UTC-2000 UTC from the Airport Park during the POW Camp celebration. W0IND will operate in the lower 25 kHz of the General phone portions of 80, 75, 40, 20, and 15m, along with packet on 145.01 MHz. For a QSL certificate, send QSL and large SASE to *Kansas-Nebraska ARC, c/o Arlan R. Campbell W0NBT, Rt. 3 Box 20-A, Concordia KS 66901.*

OCT 21-22

BOLIVAR, VENEZUELA Station YW6AF will operate during a DXpedition to the top of Angel Falls, the world's highest water fall; Sat., 0000 UTC-2400 UTC Sun. 10, 20, 40, and 80m bands will be used with SSB, CW, RTTY and packet. The QSL card will be via YV6AG. Sponsored by the Radio Club Venezolano, Chapter Ciudad Guayana (YV6AG).

Number 27 on your Feedback card

NEW PRODUCTS

Compiled by Victor Lapuszynski

KAWIN SOFTWARE

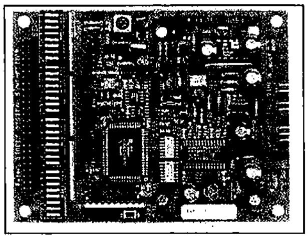
KaWin, the only Windows program to support Kantronics TNCs in Host mode, is now available for download from the Internet's World Wide Web. KaWin provides concurrent access to four TNCs, to both ports of multi-port TNCs, to simultaneous VHF packet and HF non-packet modes, for up to eight attached transceivers and as many as 26 concurrently connected stations on each radio! Each connect, as well as the background activity on each TNC port, is displayed in its own window using color-coded index tabs to select the active window.

KaWin is a fully featured communications program offering binary file transfers with concurrent chat, send and display of international character sets, extended ASCII graphics, and ANSI color graphics. Brag files and Quick Key sets are enhanced by intelligent macros that expand into everything from the currenl WX report or time of day, to commands that key and unkey your transmitter.

Users of Kantronics Kam All Mode TNCs will find nonpacket modes have become as easy to manage as packet operations. KaWin fully exploits the enhanced Host Mode features of late-model Kam TNCs to provide faster keying and unkeying response in CW and RTTY operation. Critical operating parameters such as AFSK shift are instantly reset with each HF mode change. KaWin's unique AFSK Tone Calculator solves one of the oldest problems of amateur HF digital operating: "What frequency am I really transmitting on?"

KaWin may be downloaded from the KaWin WWW Home Page, http://www.mutadv.com/kawin/. Others may choose to download from the /kawin directory at the FTP site, ftp.csn.net. This provides a fully working copy of KaWin, limited only by an insistent "nag meter" that limits each evaluation session to about 15 minutes. Registration of KaWin turns off the nag meter and is available for US $79.00. For more information, contact: *Stan Huntting KFØIA, 4655 Pleasant Ridge Rd., Boulder, CO 80301; (303) 444 2311(voice), (303) 444 2314 (fax); E-mail: stan@mutadv.com. Or circle Reader Service No. 201.*

NOVATECH

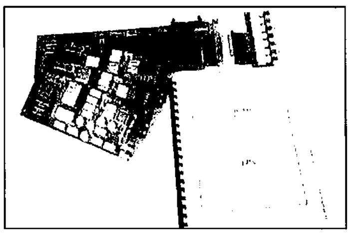


Novatech Instruments, Inc., introduces the Model DDS4m Direct Digital Synthesizer (DDS) Module. The DDS4m is a low-cost, 34-MHz signal source that combines small size, excellent stability, fast switching, and low noise for only $395 in single-unit quantities. On a 3.5" x 4.5" board, the DDS4m simultaneously outputs a precise sine wave and an accurate TTL clock signal. The output frequency is programmable from 1 kHz up to a maximum of 34 MHz in steps as small as 0.02 Hz. Typical phase noise is -90 dBc at 1 kHz offset from carrier. The desired frequency is selected by setting a 31-bit binary number either manually using DIP switches or remotely by HCMOS-compatible parallel input lines. The DDS4m contains a quartz crystal oscillator that provides excellent stability of 10 ppm per year. Fast switching is enabled since the parallel input can be driven up to about 25 MHz by external customer-supplied control hardware.

For more information, contact: *Bob O'Brien, Novatech Instruments, Inc., 1530 Eastlake Ave. E., #303, Seattle, WA 98102; (206) 322-1562, (206) 328-6904 (fax). Or circle Reader Service No. 202.*

APS

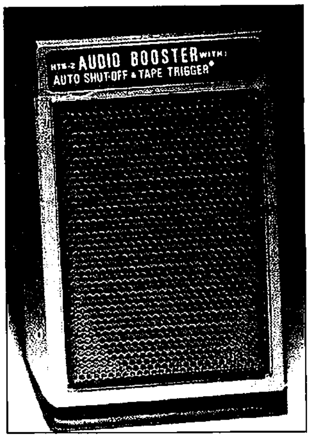
Associated Professional Systems announces the release of its Spread Spectrum Development Program (SSDP). The SSDP is an IBM PC ISA format board which can produce three independent Linear Recursive Sequence streams with lengths up to 4,394,967,295 bits long, passing through a programmable logic matrix which allows various data modulation and switching scenarios. The SSDP contains an onboard Direct Digital Synthesizer and allows external chipping rates up to 30 MHz. Several RF daughter boards are available to interface with the SSDP. It comes with a Windows control program and C drivers and is ideal for testing and development ol Wireless and Spread Spectrum systems.



For more information, contact: *Richard Schwarz, Associated Professional Systems, 3003 Latrobe Court, Abingdon, MD 21009; (410) 515-3883, (410) 661-2760 (fax). Or circle Reader Service No. 203.*

NAVAL ELECTRONICS INC.

Naval Electronics Inc. introduces the HTS-3 miniature speaker-amplifier. It's smaller than a bread box—one for those loaves you get with your soup. I'm talking 4-1/2" high by 2-3/4" wide by 2-1/2" deep. Boy, is it handy! My first application was to use it to amplify my HT receiver output and give it some beef. Then I needed some more pep from a tape recorder for transcribing notes. And then I grabbed it to help track down a problem with my hi-fi system. We all need a small speaker-amplifier around the shack and test bench.

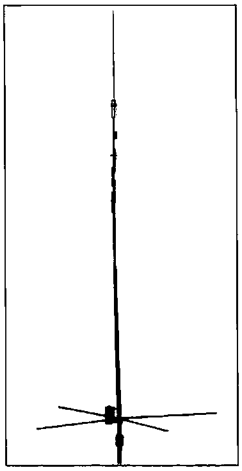


Naval did a nice design job on this one. It's powered by four AA batteries. You can use Ni-Cd rechargeables and it'll keep 'em charged if you plug in an 8-14 volt source—with either polarity! It senses a lack of activity and shuts off until there's action. Great for using your HT to monitor a repeater. There's also a recorder jack which will turn on a tape recorder and record whatever is coming through the repeater. And turn it off after. Heaven forbid you should miss something.

The HTS-3 sells for $34.95 (plus $4 UPS and $3 for packing, plus tax for Florida shipments) and will make a valuable addition to your shack. It's small enough to throw into a corner of a suitcase and take on trips, thus improving the sound of miniature radios and tape recorders, as well as HTs.

For more info, contact Naval Electronics, 5417 Jetview Circle, Tampa FL 33634; (813) 885-6091. Tell 'em Wayne sent you, or else. Or circle Reader Service No. 204.

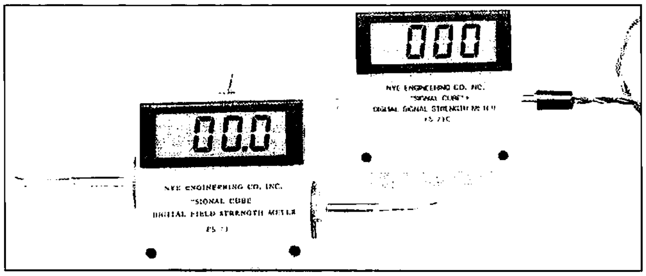
TELEX



Telex introduces its new Hy-Gain DX77 Advanced Vertical Windom with features surpassing any verticals on the market. It puts the ham world of 10 through 40 meters at your fingertips without the need for ground radial wires, and up to 1,000 watts of RF output. Automatic band switching and low angle of radiation allow for enhanced DX capabilities.

The Hy-Gain DX77 features superior quality and reliable mechanical design, with double-wall tubing, steel mast clamps, and all stainless steel hardware. The 29' vertical also features an easy tilt mount that makes lowering it for tuning a one-person job. It comes with Telex's 2-year limited antenna warranty.

For more information, contact: *Telex Communications, Inc., 8601 E. Cornhusker Highway, P.O. Box 5579, Lincoln, NE 68505; (402) 467-5321, (402) 467-3279 (fax). Or circle Reader Service No. 205.*



NYE ENGINEERING

NYE Engineering can now supply the FS73 "Signal Cube"® RF field strength meter in the form of a digital "S" meter connected directly into the RF/IF section of a radio receiver. In this form, model FS73C will provide a much higher resolution of signal strength than a conventional communications receiver type "S" meter.

The original product, the FS73 with telescoping dipole antenna, is a calibrated RF field strength meter. The new FS73C connects directly to a receiver to be a digital signal strength ("S") meter. The selectivity and sensitivity of the receiver is utilized. The price of either is $169.00 plus $5.00 shipping.

For more information, contact: *NYE Engineering Co. Inc., 4020 Galt Ocean Drive, Suite #606, Ft. Lauderdale, FL 33308; (305) 566-3997, (305) 537-3534.* Or circle Reader Service No. 206.

NOVEMBER 1995
ISSUE #422
USA $3.95
CANADA $4.95
A WGI Publication
International Edition

73 Amateur Radio Today

Simple Wattmeter

Signal Booster

Computer CW

Simplex Repeater

SPECIAL HOME-BREW ISSUE

73 REVIEWS

Alinco HF/6m XCVR
MFJ 2 m SWR Analyzer

0 74851 08725 1 11

73 Amateur Radio Today

November 1995
Issue #422

TABLE OF CONTENTS

FEATURES

REVIEWS

Toby Metz KB7UIM's life as a fifteen-year-old is anything but drab. Look on page 16 to find out why he's learning sign language from his teacher Mary.

DEPARTMENTS

FEEDBACK... FEEDBACK!

It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK list on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best.

On the cover. "I'm the person who built it, but I couldn't have raised it without good friends." Cover photo by Mike Snowden KE6HVH, who thanks Norm Larson KN6JE, Mike Zeman KE6CNO, and Ed Ginsberg KE6BNL, for helping to raise this tower, dish, and quagis at a field-day campsite. See relating story on page 10.

THE TEAM

EDDITOR/PUBLISHER
Wayne Green W2NSD/1

TECHNICAL EDITOR
Ron Galik KAØAET

MANAGING EDITOR
David Wilham

EDITORS
Joyce Sawtelle
Victor Lapuszynski

CONTRIBUTING EDITORS
Bill Brown WB8ELK
Mike Bryce WB8VGE
Joseph E. Carr K4IPV
Michael Geier KB1UM
Jim Gray W1XU/7
Chuck Houghton WB6IGP
Dr. Marc Leavey WA3AJR
Andy MacAllister WA5ZIB
Joe Moell KØOV
Carole Perry WB2MGP
Jeffrey Sloman N1EWO

ADVERTISING SALES MANAGER
Frances Hyvarinen
1-603-924-0058
1-800-274-7373
FAX: 1-603-924-9327

GRAPHICS MANAGER/ PAGINATION
Linda Drew

DESIGN/PRODUCTION
Joan Ahern

TECHNICAL DRAWINGS
Mike Nugent WB8GLQ
Various Authors

GRAPHIC SERVICES
FilmWorks, Inc.
Antrim NH

WAYNE GREEN, INC.

EDITORIAL OFFICES
70 Route 202N
Peterborough NH 03458
1-603-924-0058;
FAX: 1-603-924-9327

CIRCULATION
To subscribe: 1-800-677-8838

SUBSCRIPTION SERVICES
1-800-677-8838

Foreign Subscribers
1-609-461-8432

Reprints: $3.00 per article.
Back issues: $4.00 each.

Write to *73 Amateur Radio Today*. Reprints, 70 Route 202N, Peterborough, NH 03458.

Printed in the U.S.A. by Quad Graphics, Thomaston, Georgia.

Editorial Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Advertising Offices
70 Route 202N
Peterborough NH 03458
phone: 800-274-7373

Circulation Offices
70 Route 202N
Peterborough NH 03458
phone: 603-924-0058

Manuscripts Contributions in the form of manuscripts with drawings and/or photographs are welcome and will be considered for possible publication. We can assume no responsibility for loss or damage to any material. Please enclose a stamped, self-addressed envelope with each submission. Payment for the use of any unsolicited material will be made upon publication. Please submit all material on disk as an IBM-compatible ASCII file. All contributions should be directed to the *73* editorial offices. "How to Write for *73*" guidelines are available upon request. US citizens must include their Social Security number with submitted manuscripts.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by Wayne Green Inc., 70 Route 202 North, Peterborough NH 03458. For Subscription Services, write to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693, or call 1-800-289-0388. The subscription rate is: one year $24.97, two years $39.97; Canada: $34.21 for one year, $57.75 for two years, including postage and 7% GST. Foreign postage: $19.00 surface or $42.00 airmail additional per year. All foreign orders must be accompanied by payment in US funds. Second class postage paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm Edition—University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateur Radio Today*, P.O. Box 7693, Riverton NJ 08077-7693.

Contract: The merest glance at this constitutes a binding legal contract between you and Wayne Green, the publisher, wherein you guarantee to make a list of at least ten interesting things you can talk about on the air and post that list next to your microphone to help prevent you from being a monumental bore. You further agree *not* to mention the make or model of your rig or antenna. If you should fail on the above your punishment will be the reading of at least five pages of Section News in the advertising catalog section of a 1994 issue of *QST*

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Hey, That's Bribery!

Yep, that's about the size of it. I'm going to bribe you into (1) writing letters I can't refuse to print because they are so interesting or entertaining, (2) or you've sent me some news clipping that forces me to write some editorial, (3) or you've sent in a combo subscription for *73* and *Radio Fun* for your local library or a school library, or (4) in some other way significantly contribute to making my day a happy one (like sending me a good article, complete with a disk and photos).

You see, I'm also in the business of making compact discs for a zillion small record companies. One of the ways I've been helping them promote their music is to have our music experts listen to these CDs and rate each selection. The top-rated track from each CD is then put on a sampler CD, along with other music of the same type to help people discover, as I have, that almost all of the really creative music these days is coming from these small, independent record companies. So, in case I decide you've "made my day" with something you've submitted, let me know what kind of music you like the most. Your choices are: (a) jazz, (b) pop/rock, (c) contemporary instrumental, (d) classical, (e) world, (f) folk, (g) blues, (h) country/bluegrass, (i) Christmas, (j) music for kids, (k) gospel, (l) big band, (m) new age, (n) Cajun, (o) cargo, (p) soft rock, (q) Scottish, (r) reggae, (s) pianists, (t) fiddlers and pickers, (u) love songs, (v) perfect 10/10s, (w) Doctor Dream, (x) Qualiton Sampler, (y) Koch Sampler, (z) Secret Guide Hodgepodge. That ought to hold you! Each CD has around 15 top-rated selections, and I've got most of the CDs from which these tracks were taken available at bargain prices for hams. You'd ordinarily have to pay $15 or so for top-notch music like this and I'm *giving* it away . . . if you help to make my day.

What can you write about? If you haven't built anything interesting, can't review a new product, and haven't gone on a DXpedition, then maybe you could write about the most exciting time you've had with amateur radio? Like, did I tell you about the time I made a raft of moonbounce contacts through the big dish at Arecibo on 1296 MHz? Now, that was exciting!

Better Use?

In case you've been wondering what's become of the 220–222 MHz segment of our 220 band which the FCC confiscated because (1) we weren't using it enough, (2) we don't have an even half-way effective lobby to protect our hobby, (3) our hobby is almost unknown to the public, and (4) we don't have enough hams to register as even a faint blip with congress, our old band is alive and well and being put to some very good uses. For instance, they've been developing a new generation of digital radios for business to help cut the cost of cellular phones. They provide both voice and data channels and have been busy erecting towers for the repeaters in several areas of the country. In Florida, for instance, each tower covers a 40-mile circle and can handle a thousand customers. This has cut the costs of communications for some users from around $2,000 a month for cellular telephones to $25 a month for the new service. (Thanks W2NGN/4 for the newspaper clippings!)

Contest

Last year I mentioned that the Albert Einstein College of Medicine had discovered that when a small current was passed through the blood it prevented the HIV virus from acting and replicating. Little has been published in the medical literature since then. Does this mean that this approach has failed? Or rather that it has been successful?

The so-called health care industry is driven by the pharmaceutical companies, which seem to have firm control over the AMA, the FDA, federal research dollars, and Congress. When a new disease comes along, that means more potential profits from new drugs. Wheel So one of the last things the whole industry wants to see is an inexpensive cure for a serious illness. Or any illness.

Is it possible that something as simple as passing about 50 microamperes through the blood can end AIDS and HIV? And perhaps other blood miseries such as herpes? If you've been reading much about the FDA you know that they've let hundreds of thousands of people die by preventing the American sale of drugs that have been saving lives in other countries. There's a lot to be said for the concept of not trusting the government. I know that in my dealings I have had that concept constantly reinforced.

A physicist I know (Beck) came up with an ultrasimple approach to passing current through the blood without having to remove it from the body first. Since all of the blood circulates through the major arteries, why not hook a couple of electrodes to the body and let the current go through the blood while it is circulating? The blood has the lowest resistance, so most of the current flowing through the body will be going through the blood.

And since you don't want to mess with the body's electrical signals controlling the heart, it's best not to have the current passing through that organ. Why take chances? So instead of passing the current from arm to arm, the electrodes can be put on the ankles so the current passes through the leg arteries. No harm has come of this in thousands of trials.

We published a chart in *Radio Fun* showing the body's resistance. From that it's simple to calculate how much voltage to apply to get a net of 50 microamps. It comes to around 36 volts, which can be supplied with four 9-volt transistor radio batteries. It seems to help to keep reversing the current, which can be done with a miniature double-pole relay and a small timing circuit.

Beck found that, by using the "blood purifier" about 20 minutes a day, in a few weeks the T-cells rebuilt their strength and the HIV virus disappeared. Several hundred people have used the gadget so far and I have yet to hear of a failure to eliminate HIV. Beck believes that this should also work on the ebola virus. Considering the fatality rate for the virus, there seems little to lose in trying this approach.

Since the AIDS virus tends to hide away in the lymph glands, often for years, Bob figured that a strong magnetic field might shake it loose into the blood stream, where the purifier could then do its work. He wound a coil of wire and put it in series with an old photo-flash unit, thus inexpensively providing the zap of current for the coil. Copies of *Gray's Anatomy* are available from discount book sellers to help people find the location of the lymph glands.

So here's a challenge for you gadgeteers. Let's see what you can come up with in a simple circuit which will allow people to pass about 50 microamps through the body, switching the polarity two to ten times a second. Let's use a flip-flop instead of a relay and LEDs to indicate correct and low battery voltage. And don't forget a potentiometer to vary to voltage. Keep it simple.

Beck has been giving talks on this approach to medical groups, trying to re-educate them away from the normal drug or surgery approach to medicine. That's a tough sell.

In order to make sure that the blood purifier was safe, Beck first tried it out on himself. Instead of 20-minute sessions, he left it on for a couple of hours, as I've mentioned in a past editorial. He found that, as a result, he was losing weight. He kept on losing until he reached a normal weight for his build and then the weight loss stopped. He doesn't know just why this worked, and it's too soon to be sure of what it will do for others. But if it does replace dieting, someone can make billions! Well, they can, if they can stay one step ahead of the FDA. Or two steps.

Continued on page 74

LETTERS

From the Ham Shack

Jim Fonte KK9T Did you know that the ARRL called for a meeting of Frequency Coordinators in St. Charles, Missouri? To be invited you had to be a recognized Frequency Coordinating Entity. Pay attention to that word, recognized! This meeting was the opportunity, according to the ARRL, (and now also chiming in, the Mid-America Coordination Council, a.k.a. MACC) for the frequency coordination community to finally develop a way to get FCC acknowledgment and recognition of themselves, develop the concept of Single-Point-Of-Contact frequency coordination, put teeth into the enforcement of repeater coordination by re-instating repeater licenses, and set up a plan of national coordination standards from which all Coordinators would administer repeater frequency coordinations and band-planning.

What concern is all of this to you anyway? Well . . . read on. Oh, excuse me . . . please pardon my bad manners and allow me to introduce myself. Jim Fonte is the name. KK9T is the call. I am the Coordinator of the Indiana Repeater Council Technical Committee. Been licensed for 26 years, active on 160 meters through 23 centimeters, so I am relatively confident of what I write with regards to amateur radio repeaters.

The following story is true . . . none of the names have been changed to protect anyone!

On July 8, 1995, I was asked by one of our Indiana Frequency Coordinators if I would be interested in attending a National Coordinators Meeting in St. Charles, MO, in October. I said, "Sure . . . what's the agenda?" Well, this fellow wasn't completely certain, as he had only heard about it recently. He gave me a phone number for Lisa at the ARRL HQ, telling me to call to make my reservations for the hotel, and find out what I could about the meeting. When I finally got through to Lisa on the 25th of July, I asked her to fax the hotel info and any other stuff she had on the meeting. She said she would get the hotel info out right away, though she couldn't help me with the meeting information, but "would I like to speak to Jay for that meeting agenda?" She connected me to Jay Mabey NUØX, the guy who edits the ARRL Repeater Directory. I introduced myself and asked him what the reason was for this gathering. He said that it was an opportunity for the frequency coordinating community to get together to hammer out the process of gaining recognition from the FCC, work out all those problems that are plaguing Frequency Coordinators everywhere, and a chance to discuss the coordination of the 219 to 220 MHz band through the newly proposed Single-Point-Of-Contact System (SPOC) of frequency coordination that the FCC is insisting on. He said that this was the Frequency Coordinators' meeting, to be orchestrated in whatever manner they deemed necessary. When I asked him what the agenda was, he said he didn't know because they hadn't written it yet. They, *who*? "*We* haven't," he answered. I said, "I thought you said that it was the coordinators' meeting?" He answered, "It is!" I said, "Well, if it's the coordinators' meeting, don't you folks think that the coordinators should be setting the agenda?" He answered, "Yes, they will be asked what they want to do at this meeting, and then *we* will set up the agenda." Whoa! Let me get my bearings here! I gathered from this much of the conversation that the ARRL had probably been the catalyst for this entire sequence of events, and that I should probably ask a few more questions before drawing any premature conclusions.

I asked Jay about this supposed database for the 219 to 220 MHz band, the one the FCC supposedly wants for administration by this SPOC. Jay said, "It's already compiled . . . I did it." I asked him who authorized him to do that. He replied, "The ARRL Board of Directors." I asked him, "Who the hell authorized them to authorize you to do that?" He said he didn't know. I proceeded to tell him of my displeasure in discovering that this whole situation seems to be nothing more than a trumped-up bunch of non-issues, for the purpose of creating the illusion that the ARRL is recognizing a "real problem" and setting out to fix it! I also asked why all of these apparently earlier private meetings or discussions between the ARRL and the FCC were not reported to the general ham population in *QST*. He said he didn't know. Jay gave me an E-mail address of a fellow in Texas who is responsible for "re-mailing" information concerning frequency coordination. He also said that he would fax additional information to me about the St. Charles meeting, and that it was his hope that I would see that the ARRL is "not trying to pull a fast one," as "everyone" seems to think . . . that they are only trying to help out the frequency coordination community!

Well, its the 9th of August, and I still haven't received that hotel information or that other stuff that Jay promised to send. And I don't really expect to, either! I can tell you that the ARRL is apparently after something (what now?), again by organizing a meeting, the subject of which is *no business* of the League's . . . except maybe $$$ and their Repeater Directory. Frequency coordinators from all over the country have no choice now but to get involved, and try to reign in this situation before the League causes any further damage to processes that aren't broken and don't need to be fixed.

Remember, in the beginning of this article . . . I asked you to pay attention to the word "recognized?" Here's why. The latest version of the FCC Part 97 Rules and Regulations, Part 97.3a(20) defines what it (the FCC) thinks a Frequency Coordinator is and what it should do. Is that *not* recognition? What more recognition do we need? Do we have to have more numbers and letters attached to our call signs before we are convinced we are recognized officially? Part 97.201c defines an auxiliary station concerned with harmful interference . . . a reference is made to the Frequency Coordinator. Part 97.205c defines a repeater station concerned with harmful interference, and again, a mention of the Frequency Coordinator's role in this self-policing hobby of ours. But wait . . . there is that phrase, *self-policing*. In the old Rules & Regs there used to be a mention of ham radio being self-policing, etc. Well, I can't find that phrase anywhere in the *new* Regs, but I remember it being stated in the definition of amateur radio when I first got into the hobby. And the words and meanings stuck with me! Even if the FCC no longer absolutely, positively states that self-policing tenet, why not try to live up to that concept anyway?

Part 97.101 refers to General (Operating) Standards. Subpart (a) states, "In all respects not specifically covered by FCC Rules, each amateur station must be operated in accordance with good engineering and good amateur practice." I can read and understand this . . . why can't the ARRL? Subpart (d) states, "No amateur operator shall willfully or maliciously interfere with or cause interference to any radio communication or signal." What is so hard about that concept? Let me say it right now, loudly and clearly. I have the utmost praise for the American Radio Relay League, its technical accomplishments and publications, but geeezz, you guys need a hobby! I didn't think you folks were in business to help the FCC add more rules and regulations, and more layers of useless, stifling bureaucracy to our amateur radio hobby, but it sure seems like you're trying!

Your actions (you, the ARRL Board of Directors) are doing much to disenfranchise your membership and any others who might be thinking of aligning with you. As a very simple analogy, when was the last time you called your Congressman or State or Local Representative and said, "I don't think I'm paying enough taxes, could you see what you can do to raise them?" Or asked, "When are you going to add some more laws defining what I can do with my front lawn landscaping?" No, I'm not being ridiculous! The last thing we need to do is pester the FCC with mundane frequency coordination enforcement matters and other things that we should and can handle by ourselves! OK, I hear the gentleman in the rear with the raised fist (at me!) saying that he just can't solve *this* problem through normal means . . . he has to get the FCC involved. Fine, so be it! But just don't go whining to the FCC saying that you need to be anointed, somehow, with more power over those renegade ham operators! If you do, it's only going to be a matter of time before the FCC has had enough. "Let the auction begin! How much are we bid for this four

Continued on page 84

QRX . . .

Number 3 on your Feedback card

On-Line Ham Rag

There's a new ham online magazine on the World Wide Web. Check it out at evengraph@aol.com. They're looking for articles, letters, and so on. *TNX Amateur Radio Newsline.*

FCC Downsizes

The Federal Communications Commission may downsize and close its monitoring stations. This could have a serious impact on Amateur Radio, as we hear from Paul Courson WA3VJB in Washington:

The FCC may automate all nine of its monitoring stations across the country and run them by remote control from its facility near Washington. And personnel layoffs proposed by FCC Commissioner Reed Hunt would be another side affect of budget cutting in Congress. Hunt told the *Washington Post* that he sees a mandate to make the agency smaller. Hunt would fire 180 workers under the plan and close a dozen regional and field offices by this time next year.

If the downsizing is carried out, it would be the largest payroll reduction in the 51-year history of the FCC. But Hunt says even if the cuts in fact are carried out they might not last. He said telecommunications rules are changing and more people will eventually be needed to oversee those changes. As many as 80 additional responsibilities could come from the Telecom Legislation recently passed by the House and Senate. The bill has yet to become law. At the same time, the House has proposed freezing the commission's budget for next year. No word yet what the Senate might do.

But Hunt is acting on a worst-case scenario in the meantime. He would close nine of 25 local field offices resolving interference complaints. He would also close half the regional field offices of the FCC, cutting Atlanta, Boston, and Seattle from the six the agency now has. As for the monitoring stations, the Commissioner believes all nine can be operated remotely by the agencies main tracking facility at Gilford, Maryland, about 15 miles outside of Washington.

Hunt would preserve the enforcement workforce, while cutting jobs in public affairs and administration. The FCC in recent years has shied away from initial direct action on complaints in the amateur service, instead directing reports to a volunteer core charged with building a case. It's not yet clear whether the FCC might distance further from many intervention disputes on the ham bands, leaving it up to hams themselves to settle things or put up with problems.

Again, Chairman Hunt is talking about a worst-case scenario. Only time will tell how far the downsizing will have to go. *TNX Newsline.*

Oklahoma Hams Praised

Ham radio has received words of praise for its part in relief efforts following last spring's terrorist bombing of the federal building in Oklahoma City. Oklahoma Senator Don Nickles has entered into the Congressional Record a tribute to volunteers who helped in the aftermath of the April bombing of the Murrah Federal Building in Oklahoma City, including amateur radio operators.

In his remarks, Nickles cites an outpouring of love, selfless effort, and resources. He says that the community is indebted to those volunteers who created a silver lining to the dark cloud of the tragedy.

Specifically Nickles says that amateur radio operators provided an essential service to rescue operations. Within minutes of the attack, operators were on the scene providing an emergency communication network that allowed for the organization of supplies as well as firemen, policemen, and rescue crews from countless communities.

Their contribution of 360 hours of service, Nickles was says was made possible by donations from electronics companies such as the Oklahoma Community Communications Center. *TNX Newsline.*

Family Consecutive Calls

When couples get their licenses together it's not unusual for them to get consecutive call signs. Kathy and Don Falls of Charleton MI did. She got KB8ZZZ and he got KC8AAA. Would you like to compute the odds on that one? They're active on 2m and looking forward to upgrading to the HF bands. *TNX Amateur Radio Newsline.*

Alien Search Mounted

Now that congress has ended all NASA's SETI funding, the SETI League, Inc., hopes to involve five thousand radio amateurs in Project Argus, a renewed search for signs of extraterrestrial intelligence, which kicks off on Earth Day, April 21, 1996. If you're interested in participating in this scouring of the heavens for stray radio signals, call 800-TAU-SETI.

Cornell's thousand-foot dish at Arecibo used computers for several years, searching the skies unsuccessfully for any coherent signals. Perhaps thousands of smaller ears can do what a few very big ears have failed to do.

Recent changes to Morse Code policy in New Zealand upsets ARRL old timers

In New Zealand the Ministry of Commerce is responsible for radio policies and administering the radio regulations on behalf of Government. The Ministry recently announced a new Morse Code policy which included the following statements:

"At the present time (the International Telecommunications Union rule) RR 2735 effectively requires all administrations to verify a competence in Morse Code before the issue of an amateur license to operate in the frequency bands below 30 MHz. The Ministry has now considered this provision quite carefully and has concluded that it is no longer appropriate as a Treaty obligation for Government.

"The licensing provisions of RR 2736 provide that 'Administrations shall take such measures as they judge necessary to verify the operational and technical qualifications of any person wishing to operate the apparatus of an amateur station.' There is clearly ample scope under this regulation for an administration to require competency in Morse or not as deemed appropriate. RR 2735 adds a specific obligation in regard to Morse Code, and in so doing limits national freedom but without providing any greater benefits.

"The Ministry has therefore formed a view that it is appropriate to propose the deletion of RR 2735 at the forthcoming WRC-95 and will now work to this end. Part of this work includes, as is usual, the prior discussion of draft proposals with other administrations and this will be undertaken in the first instance in conjunction with the Conference Preparatory Meeting in Geneva next week. As such discussions continue over the next few months the Ministry will refine any New Zealand proposals prior to the formal agreement by Government of the delegation brief."

YHOTY '95

A 15-year old from Alton IL has been honored as the 1995 Newsline Young Ham of the Year. Adam Weyhaupt N9MEZ received the honors August 19th at the recent Huntsville Hamfest Banquet.

Adam was chosen for his many contributions to the community through the use of amateur radio. During the midwest floods for 1993, Adam, who was thirteen at the time, was in charge of scheduling hams for round the clock emergency communications. He also handled net control duties for a local disaster net.

The following year, Adam served as a key communications organizer for the fifteen-day U.S. Olympic Festival in St. Louis. And if that is not enough, Adam acts as a net manager for a local emergency service net. He is active in the local Skywarn Network and edits a regional Skywarn newsletter.

"Ham radio is certainly a unique hobby. It is one of the few hobbies where you can have a good time and yet help so many people. And while you should certainly have a good time. I strongly encourage all of you to use your communications talents to help other people in whatever you can do. Because that is what ham radio is really about.

"Whatever you decide to do, just jump in with both feet and do the best job that you can do. And people will remember you, because you have done such a good job and you will be helping many people."—Adam Weyhaupt N9MEZ

The Newsline Young Ham of the Year Award is sponsored jointly by *Newsline*, Yaesu USA and *CQ Magazine*. *TNX Newsline.*

A Plug for *Newsline*

We at *73* wish to express our gratitude to *Amateur Radio Newsline* for providing late-breaking news to the ham community. Audio reports can be heard over the phone at the following numbers: Los Angeles: (213) 462-0008; Los Angeles (Instant Update Line): (805) 296-2407; Seattle: (206) 368-3969; Seattle: (206) 281-8455; Tacoma: (206) 927-7373; Louisville: (502) 894-8559; Dayton: (513) 275-9991; Chicago: (708) 289-0423; New York City: (718) 284-0752; Melbourne, FL: (407) 768-7447; Houston: (713) 362-4650. Check with your local amateur radio club to see if *Newsline* can be heard weekly on the air in your area. Digital copy is available from many online services and Internet sites. For more information, contact Dale Cary WDØAKO (Internet E-mail: wd0ako@rrnet.com) or look into the rec.radio.info newsgroup.

Newsline is supported by voluntary contributions and always seems to need help with their phone bills. Contributions can be sent to: *Newsline Support Fund, P.O. Box 660937, Arcadia, CA 91066.*

Number 4 on your Feedback card

Home-Brew Quagis

A novice can build these 2m and 440-MHz antennas for under $15.

by Mike Snowden KE6HVH

I remember, as I was growing up, being awakened at zero dark hundred hours by the unbelievable roar (what I now know as intermod) of garbled voices coming from the speakers of my J. C. Penney stereo, which I had left on while I had fallen asleep. It was my father, now silent key K6YPB, attempting some DX work with his old Swan rig. Aside from the early morning cardiac test, I also remember that he always seemed to be building something. The name Heathkit was so common around the house. I often wondered where this mysterious sibling was hiding.

Now after some 37 years, I was bitten the ham radio bug. While my father would build rigs, I was just plopping down my plastic. It was not long till I began to get the urge to try some building of my own. I do not have the electronics background that my father had, and with Heathkit being out of the kit-building business (as of a few months ago, they still provide product support on some of the kits), there did not seem to be much left.

"Home-brew," as I began to learn, seemed to be a lost art form in my area. I joined a local ham club, but discovered that there were no club building events or projects. So I picked up a few books from the local ham store and began to read. My interest was soon drawn to the subject of antennas. There is an overabundance of information published on the subject and it seemed a good place to begin a foundation. Besides, these parts did not appear expensive, especially when mistakes, I mean, design changes, are made.

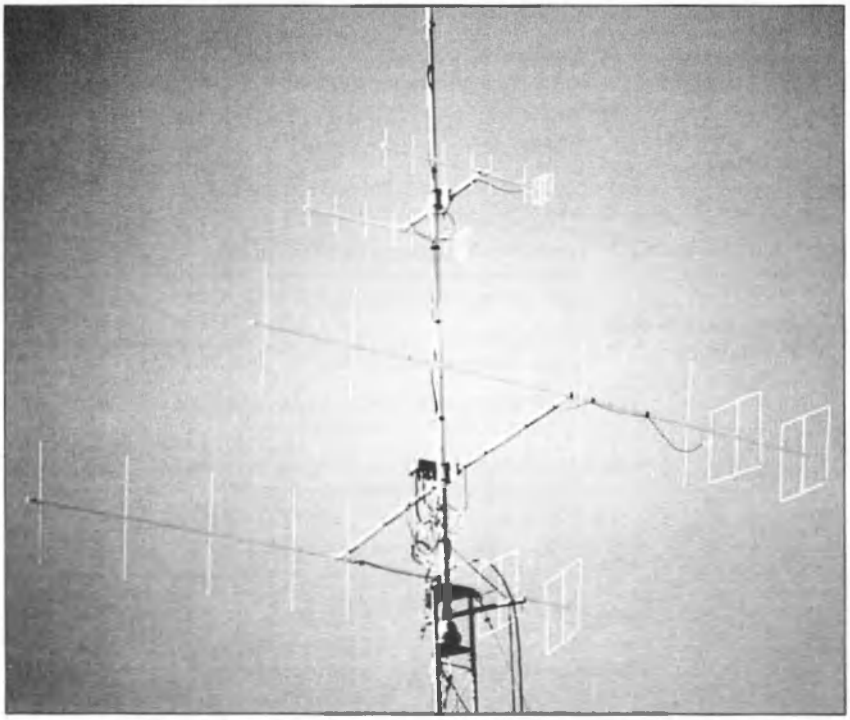


Photo A. KE6HVH's 2 meter and 440-MHz quagi antenna setup.

One of the books I found most helpful was the *ARRL Antenna Book*. It was stuffed full of designs and projects. Being a "newbie" I opted to start with VHF/UHF projects. This month's cover photograph depicts a few of my first efforts in antenna building. Even the tower was a "home-brew" project. The first two antennas were 2 meter and 440-MHz quagis. Then a 6-foot, 1.2-GHz dish, and then a second 6-foot dish tuned for 440 MHz. All designs and information were taken from the pages of the *ARRL Antenna Book*. Some design changes were made to reflect better SWR and gain. In the case of the quagis, all parts are available from most hardware or hobby stores. The 440-MHz quagi parts will cost between $12 and $15. The parts for the dish antennas might be a bit more difficult to find. I had the dishes left over from upgrading home satellite systems. They may be purchased new from most satellite dealers.

Just What *Is* a Quagi?

The quagi is a cross between a quad and a yagi antenna. The reflector and the driven element represent the quad and the director elements are that of the standard yagi. The book boasts a 13-dBi gain. In my experiments I found the quagis to be very directional with nulls developing 10 degrees off either side when vertically oriented. Cross polarization rejection is very good also, with significant drop off starting at 45 de-

grees when being rotated from vertical to horizontal. These experiments were conducted on a number of antennas built at a club building party, and the results were very consistent. In less than an afternoon, either, if not both, the 2 meter or the 440-MHz quagis can be built. The dish is a weekend project, as it requires much more effort to build. The tower is a major project requiring special skills and experience and should only be attempted by those who posses the welding and fabricating skills to complete a project of this nature safely.

For this article, we will concentrate on the building of the quagis and leave the dish antenna to a follow-up article. The following is a short list of parts and supplies that will be needed. With the exception of the boom for the 2 meter quagi, try not to vary from the described parts, as it can have an effect on the resonant frequency and SWR.

Construction

Construction of the two quagis is the same. Only the dimensions change. I will describe the building of the 2 meter quagis, but the techniques apply to both. We start by cutting the director elements. Do not use a wire cutter or other such cutting tool. Use a hobby razor saw or hacksaw. Cut the six director elements to length, starting at 35-5/16 inches and ending with 34-3/8 inches, in 3/16-inch steps. Be sure to identify each element with a marking pen to designate which element it is. For example, the first element may have one line and the sixth will have six lines. Next cut one piece of 3/8-inch wood dowel to 21 inches and another to 21-3/4 inches long. Notch a "U" shape groove in the end of each dowel, parallel to each other. The notch in the ends will hold the wire loops in place. Now cut the #6 bare solid copper wire to 85 inches long. Measure and make three marks on the wire at intervals of 20-1/4 inches. We are now going to form the reflector square loop. Grip the #6 wire with a pair of pliers so that the first mark is on the edge of the pliers' jaws. Starting with the shorter end of the wire, fold it up to a 90 degree angle, creating the first side of the loop. Now grip the wire at the second mark. While keeping the first leg of the loop pointing straight up, start to fold the wire upwards to form the second leg of the loop. Now do the same with the third mark. When done you should have a square loop with sides of approximately 20-1/4 inches (inside to inside). With a hammer, flatten the two meeting ends slightly, so that the flattened sides are parallel to each other. The flattened side will provide more surface area for a stronger solder joint. Solder the flattened joint together. This completes the reflector loop. Now cut the 10-gauge insulated copper wire to 82-1/4 inches. Strip about 3/4 of an inch of insulation from both ends. Solder the 10-32 solder lug onto one of the ends. Starting at the same end that the lug is on, measure and place a mark on the wire at 10-7/8 inches. Now, from the 10-7/8-inch mark, measure 20-9/16 inches and mark the wire. Measure and make two addition marks on the wire at 20-9/16-inch spacing. You should end up with 9-11/16 inches remaining. Using the same technique as used for the reflector, bend the 10-gauge wire into a square using the marks you put on the wire. Using the 4-40 nut and bolt, fasten a corner of the SO-239 connector to the soldering lug which you attached to the 10-gauge wire. Set both of the loops aside and now we will work on the boom.

Cut the boom material to 14 feet. Measure and place a mark one inch from one of the ends. Now drill a 1/8-inch hole through the boom, being sure that you are centered on the material and that you drill straight down. Now find a small piece of wood approximately 3/4-inch thick, 3 inches wide and 18 inches long. Using a 1-5/8 inch drywall screw, fasten the end of the boom with the 1/8-inch hole in it to the wood near the center. This will prevent the round boom from twisting as you drill the remaining holes. We are now ready to measure and mark the location of the holes for the director elements and the loop supports. Using a tape measure, starting from the end screwed to the wood, measure and place a mark at the "2-inch indication." Now pay close attention to this step so you do not end up with a boom that resembles

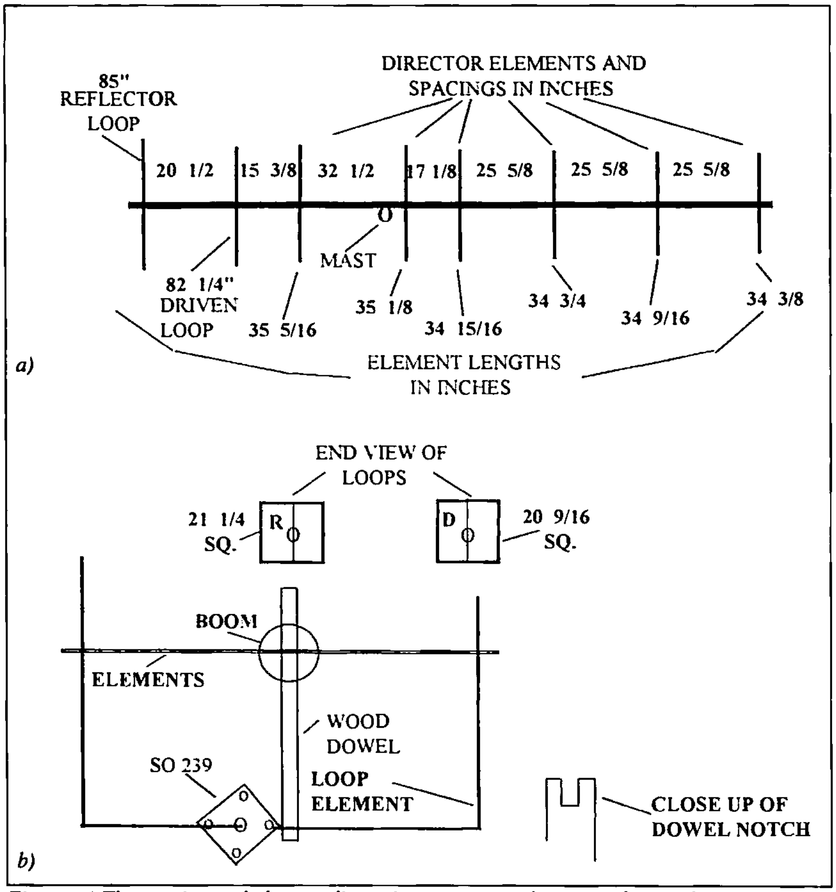


Figure. a) The spacing and element dimensions are somewhat critical. Pay close attention to your measurements. The elements are cut from 1/8" brass rod. Drill the holes in the boom parallel to each other. The elements are held in place with the silicone adhesive.
b) Orient loops with dowels vertical. Cut two wooden dowels 21-3/4" and 21" long. Notch the ends of the dowels in a "U" shape to support the top and bottom of the loops. Be careful not to distort the shape of the loop!. Attach coax to connector at a right angle and run coax back to mast.

Swiss cheese. *For all the following dimensions, you will be adding **two inches** to all the dimensions called for in the drawing.* Stretch your tape measure across the top of the boom. Take a piece of electrical tape and wrap it around the boom and measuring tape near the starting end to hold the tape measure in place. After taping, be sure the 2-inch mark on the tape measure matches the 2-inch mark you made on the boom. If all lines up we are ready to begin marking the locations of the elements. Referring to the drawing, the first spacing is 20-1/2 inches. Remembering to add the two inches to the 20-1/2 inches, place a mark on the boom at the 22-1/2-inch indicator. Continue this same technique for all remaining element spacing. Remember to add the two inches to the given dimension. When done, double-check your measurements. You are now ready to dig out the Binford super drill you ordered from Tool Time. Place the boom on a flat surface such as the floor of your garage. Use a small block of 3/4-inch thick wood under the boom as a spacer. Starting at the *opposite end*, where the drywall screw is holding the boom, position the wood spacer under the first mark on the boom, drill a 1/8-inch hole through the boom. Try to keep the drill centered on the boom and take care to drill your hole perpendicular to the boom. Repeat this same step for the next five marks. When done, you should have six holes in the boom. Measure the diameter of your boom, divide the diameter in half. Now working from the end of the boom which is screwed to the wood, use that half-diameter dimension and draw a line through the center of the boom parallel to the wood. This line will be the reference line when you rotate the boom to drill the last two holes. Remove the drywall screw and rotate the boom 90 degrees so that the reference line is straight up and down. Either drill a new 1/8-inch hole one inch from the end and refasten the boom to the wood or, while carefully holding the boom in place, drill the remaining two 1/8-inch holes at the locations you had marked. Again take care to keep the drill perpendicular to the boom. Now change to a 3/8-inch drill bit, and drill out the two holes you just drilled to the new 3/8-inch diameter. These two holes will be for the wood dowels. We are now ready to assemble the antenna. For the assembly, you might want to suspend the boom in the air by hanging it from the rafters in the garage or some similar method. Starting with the shortest director element (either the one marked as "six" or as "one," depending on the numbering system you used), insert it through the first 1/8-inch hole in the boom at the opposite end where the drywall screw was. Center the element on the boom by being sure you have equal amounts sticking out on both sides of the boom. Continue to insert the elements in ascending order. When you are done with the director elements, insert the wood dowels in the boom. The 21-3/4-inch dowel goes in the first hole (closest to where the drywall screw was) and the 21-inch dowel goes into the second hole. Be sure to orient the notch in the dowel so that it will support the loops properly. Next, after checking to be sure all the elements and the wood dowels centered in the boom, use a drop of "super glue" to hold them in place. Now install the reflector loop on the first wood dowel. Center the loop on the dowel and glue in place. Install the driven loop as shown in the cut away drawing, so that the SO-239 connector is to the left of the wood dowel, when looking at the antenna front the rear. Push the SO-239 connector against the dowel and glue in place. Center the opposite side of the loop on the dowel and glue in place. With the exception of soldering the free end of the driven loop to the center conductor of the SO-239, the construction is complete and we are ready to move on to tuning the antenna. The driven loop was cut to a center frequency of 145 MHz. Depending on your needs, you can raise the center frequency by trimming the free end of the loop. (I suggest that if you do trim the loop, do it in small steps of about 1/16 of inch at a time, soldering the end to the center conductor and checking the SWR each time.) Solder the free end of the loop to the center conductor of the SO-239.

"Note, if you use a radio to tune the antenna, use the lowest power setting possible to prevent causing interference to another operator."

Parts List 2 Meter Quagi
14' 1-1/8" i.d. Fiberglas tube or 1-1/4" pvc pipe
18' 1/8" dia solid brass rod or six 3' pieces
6' 3/8" dia wood dowel
8' #6 bare solid copper—bare wire
8 feet 10-gauge solid copper—insulated house wire
1 SO-239 chassis mount coax Connector
1 10-32 nut and bolt
1 10-32 solder lug
1 tube silicone sealer

Parts List 440 MHz Quagi
5' 1" dia PVC pipe
6' 1/8" dia solid brass rod
14-3/8" dia wood dowel
3' 10-gauge solid copper—insulated house wire
3' 12-gauge solid copper—insulated house wire
1 10-32 nut and bolt
1 10-32 solder lug
1 SO-239 chassis mount connector
1 tube silicone sealer

Tuning the Antenna

There are two simple methods to tune the antenna. The first is to use your radio tuned to your desired frequency, using a SWR meter to tune for the best SWR at that frequency. The second method is to use an antenna analyzer. I use the MFJ model 259 SWR Antenna Analyzer. If you have any desire at all to build and experiment with HF or VHF antennas, this is a must-have item. Simply hook up the analyzer up to the antenna, turn the "tuning" knob to the target frequency on the digital read out, and read the SWR and resistance. Trim the antenna if necessary, resolder and that's it. This analyzer is also great for finding the resonant frequency of those hamfest/swap meet specials.

Note, if you use a radio to tune the antenna, use the lowest power setting possible to prevent causing interference to another operator.

When you are done tuning the antenna, be sure the solder joint at the SO-239 connector is a strong one. Use generous amounts of the silicone sealer to glue all the elements and dowels in place where they intersect with the boom. Also, put some silicone sealant on the ends of the wood dowels where the loop go through the notch. Now seal the back side of the SO-239 connector with silicone. Give plenty of time for the silicone to dry, and that's it. Mount the antenna and enjoy. The antenna works extremely well in either polarization. I cut the top off a PVC "TEE," found the balance point of the antenna and used two hose clamps to clamp the two halves of the "TEE" around the boom. I also chose to use a short length of PVC connected to the "TEE" as the a mast. Using the PVC as a mast eliminates any changes to the performance of the antennas. ■

A Boy Scout's "Drab" Life

Teaching in a unique second language.

by Toby Metz KB7UIM

Not long ago, I received a letter from Mr. "Never Say Die" (Wayne Green), editor of the very magazine in your hot little hands. He wanted me to tell you about what's going on in my drab little life. I mean, I'm a 15-year-old and my life by its very definition must be drab, right?

Mr. Green wanted me to tell you about some things that I am doing now. Understanding what's happening now with me means I first must give a short bio. Although I didn't know it at the time, this whole thing started when I was a mere child of 8. You see, I've been a Scout since the second grade, and I guess that's when "it" really began. Not too much happened in my otherwise routine first four years of Scouting. I did the usual mundane things like camping, whitewater rafting, snow- and water-skiing, rappelling, exploring caves, climbing rocks, and hiking. However, about 2-1/2 years ago, at the tender age of 12, during a routine and seemingly uneventful Boy Scout meeting, a new Scout leader appeared, promising us mirth and merriment on the air waves. All we had to do was get our Technician Class licenses. But that's not quite all I did.

Since that evening, opportunities that I never imagined possible have opened up for me. First, I received my amateur radio license at the age of 12. As a Technician Plus license holder I did lots of things, including some of that mirth stuff. For openers, I was the control operator for the only SAREX ever to have come to Idaho. Talking to Col. Bolden on STS-60 was a kick! I soon upgraded to General Class and was a participant during the 1994 Dayton Hamvention Youth Forum. I'm currently the Net Manager for the Discovery Net, a youth 2 meter net that tries to get and keep young operators involved in amateur radio and their community, and am a member of our local RACES/ARES net.

Last year I called the Discovery Net in front of 600 Scouts camping in the middle of the largest set of sand dunes in Idaho during the 1994 Jamboree-On-The-Air. Yep, I was K2BSA/7. That was really kind of neat, too, because I helped organize and introduce three distinguished guest speakers for the net. The speakers included Astronaut Dr. Tony England, the Lieutenant Governor for the State, and the Chief Scout Executive for the United States. We also linked Russian amateur radio operators through a phone patch from the Boise sister city, Chita, Russia. How we did all that linking so that everyone could hear and see was a trick all by itself, and worth a future article. So much for the historical stuff.

Mr. NSD wanted me to mention a little about my latest venture. As a Life Scout in the Boy Scouts of America, I really want to be an Eagle Scout. Since I needed a Service Project, I decided I might be able to make a difference in the lives of a few people if I linked ham radio with scouting. My Eagle Scout Service Project teaches deaf children and adults what they need to know to get their no-code Technician amateur radio license. With the license and some donated equipment, I've led a group of people to assemble and repair parts that put the deaf people on 2 meter packet.

This project was a challenge right from the start. I had three major problems. The first was finding students willing to put up with me long enough to get their license. The second was obtaining the equipment; and the third was to get the students to pass! Students

Continued on page 18

Photo A. Left to right: Jake, Travis, and the author prepare to fix computers.

Photo B. The author receives sign-language instruction from his teacher Mary.

A Boy Scout's "Drab" Life

Continued from page 16

were easy to recruit. There is a school for the deaf and blind in Idaho, and through some contacts with them I found two candidates. A third deaf student joined us after he found out what I was doing.

Finding and getting the equipment turned out to be more challenging than I had originally thought. As a gentleman of 14 when I started this project, I didn't have any money. Even at 15, I don't have money, but I learned the fine art of scrounging, whining, and begging. Through a friend I learned that the City of Boise had scrapped a bunch of computers and radios. After sending letters to a City Councilman and the City Purchasing Director, and finally sending a resolution to the Mayor and Council, I had my "day in court" and presented my request to the entire council. After they had unanimously approved it, I gained possession of six well-used computers and six even more-used fire truck radios.

Naturally, to get on packet, one needs to have a TNC. Again, being penniless, I asked Tigertronics for the availability and price of their TNCs, and then the Voice of Idaho Radio Club if they would pay for them. Happily, they both said "yes." The VOI also said they would spring for the crystals for the radios. Through a money-raising project (yes, I had to get a job), I earned enough to obtain the rest of the things needed to complete the project, such as power supply parts and antenna pieces.

The next job was to put it all together. Amateurs Dave Marquart WA7QKD and Rich Dees AA7WG helped me and a few members of Boy Scout Troop 1 recycle and repair the computers and radios. The radios were not too difficult to convert. Dave did the work in his ham shack. When the crystals arrived, tune-up was a snap. Rich and the Troop built antennas and power supplies. I used a simple ground plane antenna and a really cheap and simple power supply shown in the January 1981 *73*.

Teaching was different. First, I had to learn to teach. As a kid whose life is school and homework, you'd think I would know how to teach. I've had plenty of good, bad, and really bad examples. I also had to learn to communicate in sign language. I also found I had to write out lots of words. Big terms, like "heterodyne," "oscillator," and even "Ohm's Law," are not to be found in sign language. I also found that the younger students had a difficult time reading text in the study manual. If you want to get a feel for what it's like for them, read something a young deaf person has written and you'll find they leave out words and turn phrases around. I had to remember that they work hard just to communicate, and even harder to learn the FCC Rules and how a radio works. Some of those rules appear to be written in babble anyway. Finally, I had to take it slow. If the usual time for a Novice class is 8 weeks, quadruple it when communications is not smooth. In the end, I learned to teach and talk in a different language.

"Well, the students hung in there. I struggled along and lots of people helped. The results are . . . success!"

Well, the students hung in there. I struggled along and lots of people helped. The results are . . . success! So far one person, Bill Blohm KC7JSD, passed his no-code Technician and is now working toward his General. Although the equipment and lessons were for those who are deaf, I picked up three other people my age who are also working on their licenses and are scheduled to test soon. I'm presently teaching code to Bill and his son Hans (who can hear). Two other deaf students (10 and 13 years old, respectively) are working their way toward completion of their no-code Tech. With luck, at least one of them will be testing very soon.

As I mentioned, I have received lots of support for my project, including an autographed picture and a personal note from Heather Whitestone, the current Miss America. My girlfriend has seen both. All I could say (in response to the surprised look on her face) was, "What, are you jealous? Come on, it's just Miss America!"

Some folks think it would be a good idea to keep the project going. I'd like to do that, too, but it's going to take much more equipment and support. The organization, called the VOI Education Committee, is in place, but a source for the equipment is not. Well, such insignificant things haven't stopped me yet. I'll just put my 15-year-old mind to work and see what pops out. I must say it was really great to see Bill pass his test, and it's even more fun to see Peter (the 10-year-old) start to talk to me as we build things and work on his no-code Tech. If you want to get in touch with me, I'll tell you how the lessons went in detail and what I had to learn that may be different for hearing-impaired students. Perhaps with enough interest, we can make a difference in the lives of lots of people.

Photo C. Bill Blohm, who hopes to obtain his General class license soon.

Photo D. Hearing-impaired ten-year-old Peter Foresman is studying for his no-code test.

A Simple Wattmeter

How much does your equipment cost to power?

by Edward C. Miller N7APE

At one time or another, most of us would like to get a view of the AC power consumption of some of our equipment, or maybe a grasp of the cost of having one unit or another running constantly. It's generally not something we would be on top of most of the time. Here is an idea for such a power-measuring device.

All that is needed is a small power transformer with a low-voltage secondary or a transformer from an old tube-type receiver. The winding voltages are not that important; it's the ratio that counts. If it has a 120-volt primary, and a secondary of 12 volts or less, it will do fine. Or, if you are one of the old timers, you may have a filament transformer. It would likely have a 120-volt primary winding with the secondary maybe 6.3 volts, center-tapped. It was the latter that I discovered among yesteryear's parts.

If there is nothing like that around your shack, a parts house should have a small transformer with a 120-volt primary, and perhaps a multi-tapped secondary with relatively low voltages (2 to 6 volts) between taps. I wouldn't recommend using low-voltage units such as mini-audio units, as their insulation may not prevent breakdown, especially if the meter is used on a 240-volt line. What we are looking for is a fairly high primary to secondary ratio. The transformer I used had a ratio of 38:1 (120 V/3.3 V). To keep things simple, I will not refer to the windings as primary or secondary, but rather low voltage and high voltage.

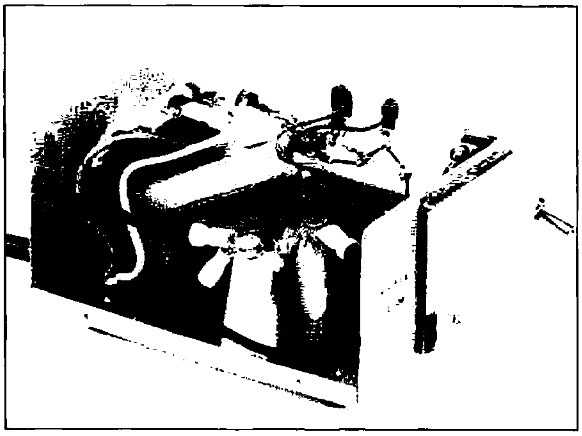
The low-voltage winding is placed in series with the 120-volt line, and bridged with a very low-value resistance. The output of the high-voltage side is rectified and filtered, and its voltage measured by a meter. (The most desirable meter would probably have a 200 or 500 µA range; a lot of them are available on the surplus market). Although this circuit uses a micro-amp meter, it is really measuring the rectified and filtered voltage of the high-voltage winding. As this voltage is proportional to the voltage on the low-voltage winding caused by the current flow through it, the meter will, in fact, be a measure of the line current.

The resistor across the low-voltage winding should be of a value that will reduce the current in that winding to the minimum level that gives a meaningful voltage for the meter on the high-voltage side. A short section of heater element wire (obtainable at most hardware stores) was used for this purpose. Its value should be between .1 and .2 ohms. A practical step is to compute the ratio of the high/low windings. A ratio of 30:1 or better is best, but a ratio as small as 10:1 will do. Assuming that R-1 is one tenth of an ohm, and the ratio is 30 to 1, then 1 amp through it will produce a voltage on the high voltage winding of about 3.8 volts, and cause only a one-tenth-volt drop to the device whose power is being measured.

When the load is small (40 watts or less), the voltage drop across the rectifiers would reduce the accuracy of the measurement. That is, the reading on the meter would be nonlinear at the low end of its scale. Therefore, diodes D-3 and D-4 are placed in series with the meter, and are forward biased with the battery and R-5. Because this offsets the voltage drop across D-1 and D-2, the meter reading is accurate, even at very small loads. The meter shown in Figure 1 is a 200 µA calibrated zero to 5 (that is, zero to 500 watts at 120 volts).

Calibration is accomplished by applying 120 volts to the input circuit, with a known value load on the output (100 watt lamps, for example), and adjusting the R-3 trimpot to get the right reading. The meter reading will then represent the wattage at 120 volts.

This unit may also be used without modification for measurement at 240 volts. At this voltage, for a given wattage consumption, only half as much current is flowing through the measuring circuit. So the power reading must be doubled to get the true power drain.



Front left view of the innards.

Layout is not important. Although in the unit shown in Figure 2, the diodes, capacitors, and trimpots were mounted on a PC board, that certainly is not required. Point-to-point wiring and the use of standard-size potentiometers would do just as well. The power switch, in the AC line, should be capable of switching at least 5 amps. Although a DPST switch was used in the unit shown, the AC power could be switched with a heavy-duty SPST switch, with a mini-switch to disable the battery when the unit is not in use.

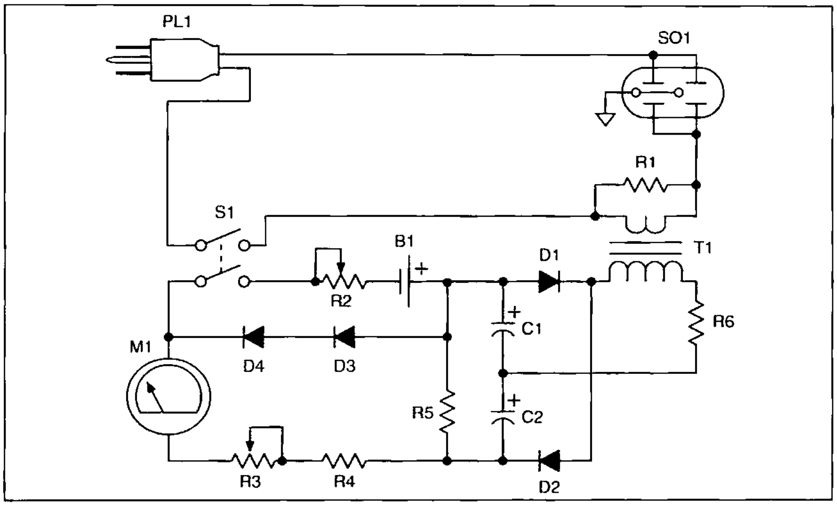


Figure 1. Power meter.

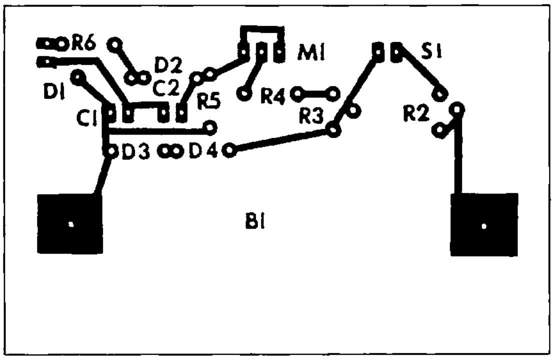
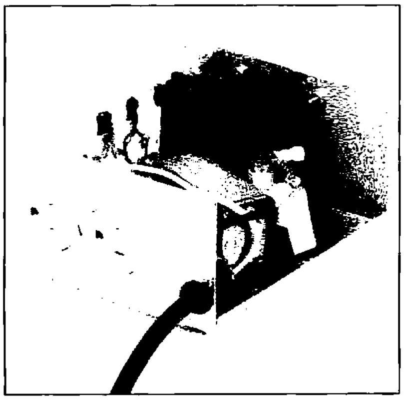


Figure 2. PC board pattern.

Many of the component values are dependent on the transformer chosen, and on the value of the shunt resistance. This includes the voltage ratings of the capacitors, and the value of the resistance in series with the meter.

If you have an AC voltmeter, it would be best, after all the parts are mounted, to leave the wires from the high-voltage side of the transformer disconnected from the rest of the circuit. Double-check that the resistor is solidly connected across the transformer low-voltage winding. Power it on, and measure the voltage across the high-voltage side with a 100-watt load. A reading of 1 to 3 volts should be expected. A reading much higher than 3 volts would indicate a need to use a smaller value for R-1; and a reading of less than 1 volt shows that the R-1 value should be increased.



Rear view

Parts List

B-1	AAA Nicad Battery
C-1, C-2	20 µF/25 V electrolytic capacitors
D-1,2,3,4	1 A, 100 V diodes
M-1	200 µA-meter
PL-1	AC Plug
R-1	0.1-ohm resistor (see text)
R-2, R-3	100K-ohm trimpots
R-4	15K-ohm 1/4-W carbon resistor
R-5	220K-ohm 1/4-W carbon resistor
R-6	680-ohm 1/4-W carbon resistor
S-1	DPST 10-A Switch
So-1	Standard AC socket for unit under test
T-1	Power transformer (see text)

The Capacitator

You'll get a charge out of this!

by Brian Field VK6BQN

The following is a weekend-type project, simplistic in design, and, depending upon how well stocked your junk box is, cost should only be a few bucks.

The need for this device became apparent when I was trying to make a fairly long-term 555-type timer, and had difficulties only because the large capacitor I used was a bit leaky. The capacity read out OK on a capacitance meter, but the time was way out because the associated resistance was being shunted by the leakage resistance.

Reference to the *ARRL Handbook* suggested no better than to watch the charge/discharge action on an ohmmeter, which, when you think about it, tells you absolutely nothing because of the relatively low resistance. Even a FET-type meter is deceiving at 11 Meg, when the timing resistor itself is like 10M or so. "There has to be a better way."

So with necessity being the mother of invention, etc., the "Capacitator" was born.

What we want is something that will charge the capacitor to its rated voltage rather quickly, then *hold* the voltage there. If the capacitor is leaky, then the voltage will dissipate through the leakage resistance and be gone. That means we want to observe this voltage without the meter itself draining away the charge. Since everything commonly found that does this has a divider chain of around 11M, something else will have to be devised. An arbitrary value of 50M was chosen for this, as it was felt to be achievable; anything higher like, say, 100M would probably be problematical due to insulation leakage around flux, even finger dirt.

Charging is no problem, we merely use a different divider chain to do this, and arbitrarily chose 20k, so that at 100 V, the chain itself only draws 20 mA from the supply, thus making it small enough.

The whole idea, then, is to charge the capacitor from this supply, isolate it, then observe how long the charge stays there. And with a 50M output load, even a 1-µF capacitor can be observed without too rapid a "sag" through the meter. (T = RC, 50M x 1 µF = 50 sec., so only 2/3 of the charge should be gone in 50 sec. or total discharge should take [about] 3T, or 150 seconds.)

The voltage scales chosen were felt to reflect what is commonly found in the junk box, including 3-V tantalums. (Tants are very seldom leaky, but rather tend to be either open or shorted, especially if they have seen wrong polarity voltages.) 100-V was chosen as the maximum, due to safety considerations, and seldom is a 100-V or higher cap encountered nowadays, except in valve [tube] equipment. If finding a 9-position switch becomes a problem, then some of these voltages might have to be done without.

Notice in the diagram that there is a

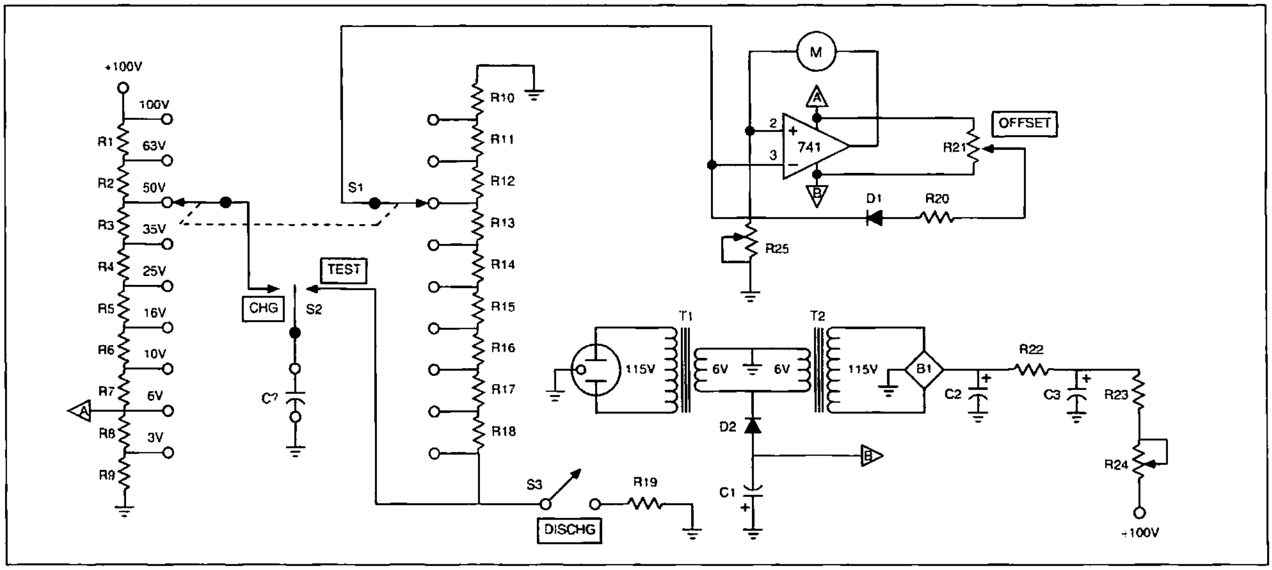


Figure 1. Schematic of the Capacitator.

corresponding voltage tap on the "discharge" chain for each tap on the "charging" chain. This allows the meter to be set for full-scale deflection equal to that voltage. More on this under "Using the Capacitator."

Construction

The entire device fits into a 3" x 4" x 5" box, but if I had it to do all over, I would have made it into a slightly larger box. A lot of it depends upon whether you use a 2-inch or 3-inch meter. Do *not* spend big money on the meter, as the only points to look at on the meter are full scale and zero. *Any* meter movement will do; if you use other than a 1-mA movement, it's only a matter of adjusting R25 to make up the difference. The meter and R25 are made to read 3-V full-scale. So for a common 1-mA movement, R25 will be about 3k. Note that the meter resistance makes no difference.

S1 is a 2-pole 9-position rotary, and all the resistors are fitted directly to the switch terminals. S2 is an old telephone-type lever switch, with a center off. I adjusted the discharge side to have a detent, the charge side to have a spring return, as charging usually only takes a second or so (under, say, 10,000 µF). If you can't find one of these, you may have to settle for a rocker-type, but it's worth it to find the center-off type. I mounted this switch horizontally at the bottom of the front panel so that it could be operated with the thumb while holding the box steady with the rest of the hand. S3 is an ordinary NO push button, mounted on top of the box, next to the test terminals. Get used to discharging any cap before sticking your fingers where they shouldn't be! Even at a relatively low voltage of 25-V or so, a lan cap can make a nasty "snap" if not discharged gently through a resistance. There certainly isn't anything critical about the value of R19, but too low may allow too much sparking or pitting of the contacts after awhile; too high and you may have to wait awhile for larger caps to come all the way down. Do *not* use a dinky little switch for this reason; they just won't take the heat. Use instead one of the American or British large black types rated at 2 or 3 amps.

U1 is an ordinary everyday op-amp, 741 probably the cheapest/easiest to find. R21, R24, and R25 are all screwdriver adjust pots. Not necessary to use 10-turn types, but if that's what you have, OK. There isn't really anything critical in the value of these either. R20 can be any value above a few Megs. D1 is used to isolate the offset voltage from the discharge path, else the discharging cap would bleed off through here, shunting the 50-Meg chain.

In calculating the divider resistors, many nonstandard values are needed. Readers are referred to my freeware program (found on all good BBSs as "Divider.bas" or the Q-basic version, "DividerQ.bas") which can find a resistor pair to make almost any resistance required. Common 10% resistors are used to make up these combinations and are listed here in the parts list. It's much easier to put two resistors in parallel around the switch terminals than to use two in series.

The power supply uses two back-to-back transformers, they can be either 6- or 12-V types, just so long as they are the same. This gives us isolation from the line, as well as the opportunity to make a small negative voltage for the op-amp. Since it needs only 1 mA or so, an ordinary glass diode will do for this. There is absolutely nothing critical about component values here, or indeed in the +100 supply, except WVDC on the two filter caps, and of course the bridge must be able to handle 200 PIV. No regulation is provided. Not worth the bother.

Note that if a 12-volt transformer is used at T1, then "point A" should be moved to the junction of R6 and R7, to make the offset adjustment at R21 easier. The bridge, two caps, and R22 I hard-wired into place where they would fit between the trannies, meter, etc. Everything else I put onto a small piece of perfboard for convenience.

Smoke Test/Calibration

If you don't get that burning phenolic smell when plugging it in, then calibration is only a matter of a voltmeter and 2 minutes. Put a 100-V meter on the top of R1 and set R24 for 100 volts. Depending on what you used for C2 and C3, R23 may have to be changed to bring R24 into range. Now put the voltmeter on the point between R8 and R9, and ensure that this point is 3.0 volts. This is more important since it will be used to calibrate the meter itself. If it is off by more than a tenth of a volt or so, adjust the values of R8 and R9 to get it there. (All this with S2 in the open, or center position.)

Next, attach a temporary lead from this same point (junction of R8 and R9) to pin 3 of the op-amp. Adjust R25 for the meter to read full scale. This now makes the meter a 3-V f.s. meter. It will always be this, because at higher voltages the resistor chain divides the applied voltage down to 3-V.

Lastly, remove the temporary lead and adjust R21 for meter zero. You may have to reiterate these two steps once or twice to get the desired result. That's it! The Capacitator is now ready for use.

Using the Capacitator

The best way to show how to use the Capacitator is to walk through the whole process with an example. Hook up the capacitor to be tested to the terminals (mind polarity!). Let's use a 100-µF, 6-V electrolytic for this example. Set the voltage selector to 63-V. Flick the lever switch over to charge for two or three seconds. Then move it to "test" and the meter should immediately go to full scale. And *stay* there for quite a while. It's OK to watch the voltage *slowly* bleed off; the 50-Meg divider is doing this. If leakage is of *real* concern, set the lever switch to the center. The capacitor now is completely isolated. Go have a cuppa coffee and come back in half an hour or so, again put the lever switch on "test," and the voltage (theoretically) should still be at full scale. (This is where we learn that *all* electros, even brand-new ones, leak a little.) With practice, especially on smaller caps, you will quickly get the idea of what is leakage in the cap, and what is being drained off by the divider chain. In the earlier example of a 1-µF capacitor, we say that 2/3 of the charge will be gone in 50 seconds, which should give some idea of what to expect.

We encountered an unexpected bonus after construction of the device, in that when we are charging a capacitor, the current drawn by the cap upsets the amount of current being drawn through the divider chain, hence the zero offset voltages change slightly, and the meter dips below zero. As the capacitor nears completion of its charging, the meter returns to zero. This serves as an indicator that the capacitor is charging while holding the lever switch in "charge." On small caps, this is hardly noticeable; on larger ones, you now know how long to hold it on charge.

Every now and then, charging and charging will only get the cap to read about half scale. This indicates (obviously) the cap won't take the full charge. It does *not* mean the cap is bad, only that it needs to be reformed. Sometimes charging, discharging, charging again, etc., will bring it good. Other times, set the voltage two steps below the rated voltage, charge it up, leave it sit there a short time, discharge it,

charge it up to the next higher voltage, etc., and maybe it will come good by the time you return to the rated voltage. Note was made that when a cap is like this, the meter will stay below zero when charging, indicating that it is always drawing current. Right here is where you know that, as is, you can't really use it in your circuit!

Take a "Touch Plate"

If you have a handful of pullouts to check, with really short leads, it's a lot easier to make a touch plate, than to fiddle around with alligator clips, holding the clips apart with one hand, etc. A touch plate is any piece of *plated* circuit board (bare copper soon tarnishes and it's hard to make a good contact with bare leads), about 1" by 3". Cut a separation down the middle of the foil with a hacksaw, or whatever, about 1 mm wide. Solder leads on each of the two pads and hook *them* up to the meter. Now all you have to do is hold the cap by the middle, leads pointing down, and touch them into the pads. This little plate can be used for other testing devices as well, and I have used a 3-way for transistors. (Use your imagination.) Fair warning, though: when using the 63- or 100-volt ranges, don't put your fingers where they shouldn't be. Note the negative side is grounded, so if your hand rests against the plate, make sure it's *that* side. ■

Parts List

B1	200-PIV bridge rectifier (WO2)
C1	47-µF, 25-V electrolytic
C2, 3	4-µF, 160-V electrolytic
D1, 2	any glass diode, e.g., 1N4148
R1	7400-ohm 8200I82k
R2	2600-ohm 3900I8200 or 4700I5600
R3	3000-ohm 4700I8200
R4	2000-ohm, 2 x 1k series
R5	1800-ohm
R6	1200-ohm
R7	800-ohm 820I33k
R8, 9	600-ohm 1200I1200 or 1kI1500
R10	1.5M
R11	880k 1.2MI3.3M
R12	620k 680KI6.8M
R13	1.2M
R14	1.7M 2.7MI4.7M or 3.3MI3.3M
R15	3.3M
R16	5.6M
R17	10M
R18	25M 10M series 15M
R19	120-ohm, 2-W (not critical, see text)
R20	10M (not critical, see text)
R21	100K trimpot (not critical, anything over 20k)
R22	12-ohm, 1/2-W
R23	1k
R24	1k trimpot
R25	5k trimpot
S1	2-pole 9-position rotary switch
S2	2-pole lever switch (see text)
S3	pushbutton, n.o. (see text)
T1, 2	115-V/12-V or 115-V/6.3-V—both to be the same.

Crystal-Controlled Audio Generator

Clean, reliable frequencies from junk box parts.

by J. Frank Brumbaugh KB4ZGC

Most hams have occasional use for a relatively clean source of audio within the most important range: 300 to 3,000 Hertz. If that source is variable in both frequency and level, it will be even more useful. The commercial audio generators available are far too expensive for most hams, and their extended range of frequencies is far wider than most hams could ever use. You can construct simple, fixed-frequency audio oscillators for specific—but generally only approximate—frequencies when the need arises, if all parts needed happen to be in the junk box. But usually Murphy makes certain that at least one critical component is missing and cannot be located.

What is needed is a simple, inexpensive, accurate variable frequency generator that can be built from mostly junk box parts, easy to put together and easy to use. It should have a reasonably clean sine wave output available at both high and low impedance levels, both of which are variable at will. Even though the frequency generator may not be used every day, it will be on the shelf when the need arises, and once you have it you will find more and more uses for it.

One of the generator's most obvious uses is constructing and adjusting active and passive audio filters, and measuring their bandwidths. Two can be used for two-tone testing of sideband transmitters. It can be used as a code practice oscillator. It is also handy for checking the audio stages of many kinds of equipment from ham gear and portable radios to TV sets and public address systems. No doubt many more uses can be found.

The instrument described here represents an entirely different approach to the generation and control of audio frequencies. It combines the principles of high-frequency heterodyning with the "rubbering" of a crystal oscillator. The difference frequency between two stable, crystal-controlled oscillators, one of which is variable over a few kHz, provides a useful range of accurately known audio frequencies. Because these audio frequencies are generated by a pair of crystal oscillators, the output frequency will be as stable as the crystal oscillators, especially important in the design of active audio filters.

Circuit Description (See Figure)

U1, a 74LS00 Quad 2-input NAND Gate chip (or a 4011 with different pinout) is connected to form two separate crystal oscillators, each using two of the four NAND gates on the chip. Surplus microprocessor crystals at a frequency of 10 MHz are used to ensure a more than sufficient range of audio frequencies at the output of the generator.

Both 10-MHz outputs from the oscillators are fed through emitter followers, Q1 and Q3, which serve to isolate the oscillators from each other and prevent the pulling of one oscillator as the other is rubbered.

Outputs from both emitter followers are fed to Q2, which is a simple mixer. Because the sum frequency of approximately 20 MHz is so far removed from the desired difference frequency in the lower audio range, it is ignored rather than being shunted to ground. The difference frequency, controlled by C3, an air variable capacitor in the rubbered crystal oscillator circuit, is applied through C8, 4.7 μF, to the top of LEVEL control, R13, a linear 10k-ohm potentiometer.

The position of the wiper of R13 establishes the level of audio available at J1, the Hi-Z output connector. At the same time, the audio at the wiper of R13 is also applied through C12, 4.7 μF, to the base of Q4, an emitter follower which produces its output through C13, 470 μF, to J2, the Lo-Z output connector. Thus, the single level control varies both high- and low-impedance audio levels simultaneously.

U1 is supplied with +5 VDC through U2, a 78L05 regulator. Transistors are all supplied with operating voltage directly from the 9-volt battery. Current drain is a nominal 30 mA. No LED is included to hold current drain to a minimum. A 9-volt alkaline battery is rated at about 565 mA hours, and the additional current required by an LED would reduce battery life unnecessarily. However, if the station power supply is used to power this generator, addition of an LED to indicate Power-On would be okay.

Theory of Operation

One fixed crystal oscillator and one variable crystal oscillator are separately buffered through a pair of emitter followers, Q1 and Q3, then are combined in mixer, Q2. The difference frequency between the two crystal oscillators is taken from the collector of Q2 and applied to the LEVEL control, R13. Adjustable output from R13 is applied through C9 to the HI-Z output connector, J1, and also through C12 to the base of emitter follower, Q4, whose low-impedance output is routed to Lo-Z output connector, J2.

Parts

Because this is primarily a junk box project, most parts—except the variable capacitor—will be found in your junk box, or are readily available from Radio Shack and numerous mail order electronic parts dealers. The best source for a suitable variable capacitor is the hamfest flea market. Other hams may also have just what you need, especially older hams who may still have war-surplus capacitors in their junk boxes.

The APC-type capacitor, which

mounts through a shaft hole but with a pair of 4-40 machine screws, is preferred, and it is also fairly small. Most still available on the used parts market have no shafts, and are designed as padder capacitors and adjusted with a small screwdriver. However, you can make a shaft from a short length of 1/4" copper tubing by carefully filing down the portion with the screwdriver slot and reaming out one end of the copper tubing. The shaft can then be soldered to the capacitor. Because the shaft (or screwdriver adjust) of an APC capacitor extends through the panel through an oversized hole, the rotor is not grounded. A large plastic knob on the shaft reduces the inescapable frequency shift caused by your fingers.

If a tuning capacitor intended to be mounted with a nut through the panel is used, it must have both rotor and stator insulated above ground. Fiber washers—one flat and one shoulder—can be used to insulate effectively this type of capacitor from ground. Another method is to make an oversized hole in the panel through which the shaft bushing will protrude without touching the panel. Back up this hole with a small sheet of insulating plastic or phenolic, and mount the capacitor with its shaft bushing and nut through the insulating sheet, which is fastened to the panel with two small machine screws, lockwashers, and nuts.

As a temporary measure, if you use an APC-type capacitor and need to use this generator before adding a shaft and dial to calibrate, you can use a small screwdriver to set the needed frequency (it should be insulated) and a frequency counter to determine the frequency.

One source of inexpensive air variable capacitors is Fair Radio Sales, Inc., P.O. Box 1105, Lima, OH 45802-1105. Suggested is Catalog No. 657-J3, 8-55 pF, 79 cents, a screwdriver adjust APC type. Also, Catalog No. CT13E099M, 10-100 pF, $1.50; Catalog No. 6CT1C075, 6-75 pF, $1.25, all of which are APC types to which you'll need to add a shaft.

If the capacitor you use has too much maximum capacity, rotor plates can be removed—carefully—with needle-nose pliers. If its minimum capacity is too low, you can add a small trimmer capacitor in parallel.

Assuming you must purchase all new (surplus) parts and manage a lucky trade or purchase of a usable variable capacitor, the total parts cost, excluding the case, will be under 10 dollars.

Because the heart of this generator operates at 10 MHz, it is strongly recommended it be constructed in an aluminum box, or a case made of copper-clad printed circuit board material.

Construction

I recommend using a Radio Shack general-purpose printed circuit board (276-150), which is what I used. You can also use perf board. Because the circuit diagram (see Figure) is far larger than the finished generator, there is plenty of room on the Radio Shack board.

You will find it easiest to mount some resistors vertically, and make certain all the parts associated with U1 are mounted as close to it as possible. A socket can be used, but it is not required for U1. If you decide to use a 4011 chip instead of a 74LS00 to reduce current drain, make the necessary changes in the circuit caused by the different pinout. Although ceramic disk capacitors can be used, monolithic capacitors are preferred because they are much smaller. You can use any small signal NPN transistors instead of the 2N3904 types specified, without any problems.

CAUTION: Make certain that both shaft and rotor of the variable capacitor,

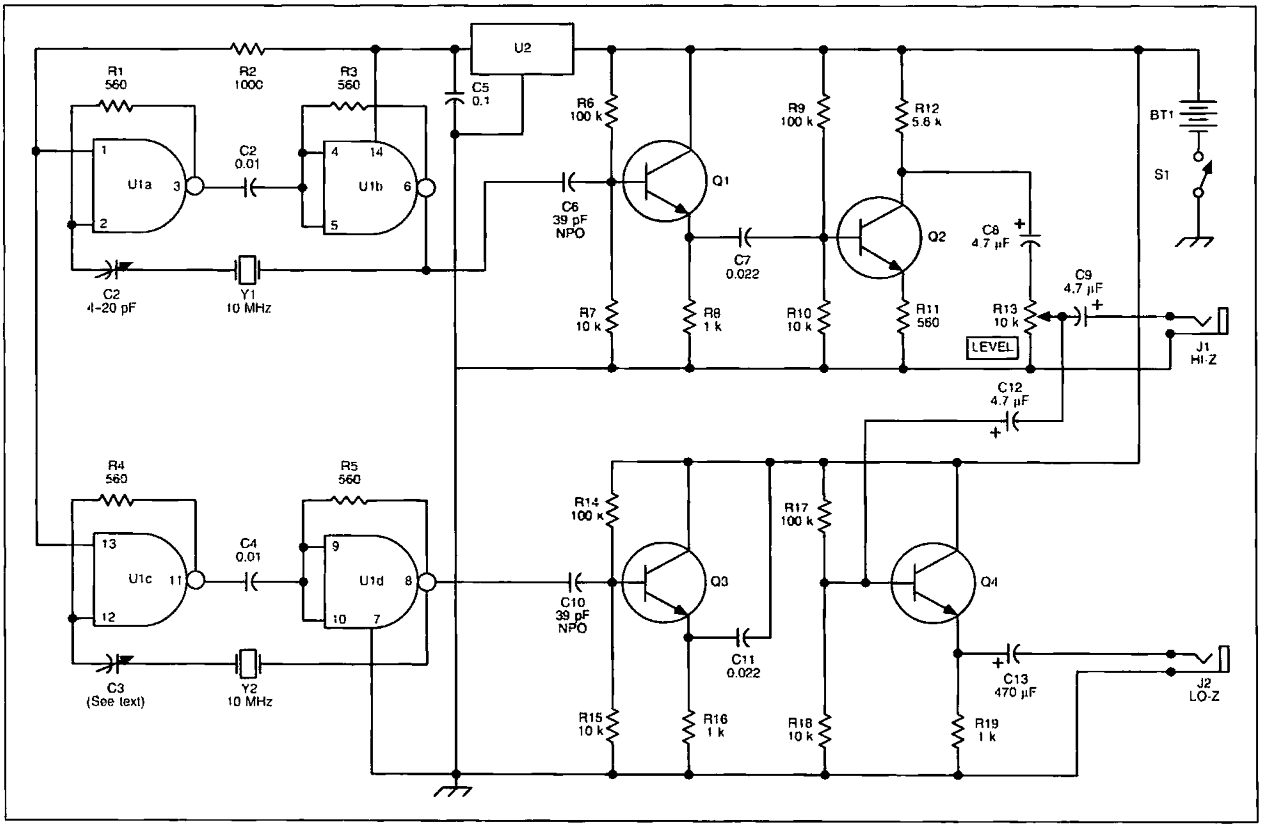


Figure. Schematic diagram of crystal-controlled audio generator.

C3, are insulated from ground. A grounded capacitor will prevent one oscillator from functioning, and no audio output will result.

Use a large plastic knob on C13. The output frequency will change slightly when your fingers are on the knob, and return to normal when you take your hand away. This is a minor drawback, but the only way to eliminate it is to use a rather large enclosure, and an insulated shaft coupling on C13, with a grounded shaft bearing at the panel. Shaft couplings of any kind are scarce and very expensive, as well as taking up more room. However, you can make an insulated shaft coupler from a 1/2"-square or round plastic rod. Drill a 1/4"-diameter hole through it from one end to the other. On one side, drill and tap two small holes for setscrews into the central hole. A defunct potentiometer can be taken apart to provide both a shaft bearing at the panel, and the needed short piece of shaft.

If you wish to eliminate the 9-volt battery, substitute a 78L09 regulator and operate this generator from your station power supply. Although I didn't try it, there is no reason it shouldn't function perfectly, though with increased output, from 13.8 VDC.

Although 10-MHz crystals are specified, you may use any crystals that are marked for the same frequency, as long as they are no higher in frequency than 13 MHz. The 78LS00 will not oscillate much above 13 MHz. The higher frequency you choose, the greater the resulting audio range will be. Surplus microwave crystals are usually produced within 500 ppm, which means the actual oscillation frequency, without series capacity, can be anywhere between 9.9925 and 10.0075 MHz. Placing a capacity in series with a crystal will increase its frequency of oscillation by about 2 kHz, and increasing the capacity will lower the frequency.

Calibration

Because of the wide tolerances of microprocessor crystals, calibration is a bit more complex than tweaking a trimcap. I ended up using a 25-pF variable capacitor in series with a 9-pF NPO capacitor. This resulted in a frequency range of about 100 Hz to over 3,000 Hz. Because your crystals are different, your treatment of C3 will no doubt be different. You will have to try different values of tuning capacitor; you will probably have to vary this value with either or both series and parallel small value capacitors.

Basically, adjust C3 to minimum capacity, then adjust C1 for a frequency lower than 300 Hz, using a frequency counter connected to the Lo-Z connector, J2. Then slowly advance C3, monitoring the frequency until it is at maximum capacity. If the U1c-U1d oscillator stops oscillating, your maximum capacity is too high. Either remove rotor plates, as suggested earlier, or try different values of small capacitors in series with C3. Each time you change the effective value of the variable portion of C3, you will again have to adjust C1, with C3 at minimum capacity, for a frequency at the low limit you select, normally a bit below 300 Hz. Again set C3 at maximum capacity and check the frequency.

It may take several attempts to get the range encompassing the desired 300–3,000 Hz spectrum. Initially, the range you measure will probably cover from 300 to 5 or 6 kHz. This indicates that the amount of capacity variation of C3 is too high, and points to the need for reducing it. Series capacitors of various small sizes will allow you eventually to capture the needed 300–3,000 Hz range.

It will help also to feed the output signal through a small amplifier into a speaker. Not much amplification will be needed, and in fact, the Lo-Z output will produce a weak signal when fed directly into a speaker. There may be occasions where, while adjusting C3 from minimum capacity, you will go through zero beat. This requires readjusting C1 slightly. The frequency change while adjusting C3 through its range should be smooth, from low frequency to high, as C3 is adjusted from minimum to maximum capacity.

Unfortunately, rubbering a crystal with a capacitor does not result in a linear change in frequency. Thus, you will find that the low frequencies, as you mark calibrations on the dial, will be crowded, while the higher frequencies will be more spread out. However, while this makes adjusting for a frequency below 1,000 Hz—as when checking an active or passive CW filter—a bit more difficult, you can be assured that the frequency you set is both accurate and completely stable, because it is crystal controlled.

Conclusion

Because I neither own an oscilloscope nor have access to one, I could not observe the waveform. It sounds clean to my ear from a speaker fed by an LM380 amplifier with the input gain turned low to avoid any distortion in the amplifier.

Should anyone who builds this generator find any distortion in the waveform, which should be a sine wave or very close to it, he or she may be required to change some parts values associated with the four transistors, Q1 through Q4. Because I have no way of knowing if distortion exists, I cannot make any suggestions as to possible changes.

I have used this instrument primarily for checking peak frequency and bandwidths of active CW filters. It functions as designed, and provides the information I look for.

The C3 capacitor I used—and no doubt yours will be similar—has "constant capacity" plate shapes; its capacity varies linearly as the plates are enmeshed. An older ham might be able to help you locate a tuning capacitor with "constant frequency" plate shape, such as were very common in the 1930s. Using this plate shape should spread out the low-frequency end of the frequency range, but may also tend to crowd the higher frequencies. With this plate shape, capacity change is slow as the capacitor is adjusted from minimum capacity, and becomes much more rapid toward maximum capacity. 73

Parts List

BT-1	9-volt battery
C1	4-20 pF trimmer capacitor
C2, C4	0.01 μF monolithic capacitor
C3	Air variable capacitor (see text)
C5	0.1 μF monolithic capacitor
C6, C10	39-pF NPO monolithic or disk capacitor
C7, C11	0.022 μF monolithic capacitor
C8, C9, C12	4.7 μF 16-volt electrolytic capacitor
C13	470 μF 16 volt electrolytic capacitor
J1, J2	Output connectors, builder's choice
Q1, Q2, Q3, Q4	2N3904 or equivalent NPN small signal
R1, R3, R4, R5, R11	560-ohm, 1/4-watt 5% resistor
R2, R8, R16, R19	1k-ohm, 1/4-watt 5% resistor
R6, R9, R14, R17	100k-ohm, 1/4-watt 5% resistor
R7, R10, R15, R18	10k-ohm, 1/4-watt 5% resistor
R12	5.6k-ohm, 1/4-watt 5% resistor
R13	10k-ohm linear taper potentiometer
S1	SPST switch
U1	74LS00
U2	78L05
Y1, Y2	10-MHz microprocessor crystal (see text)

Easily Constructed General-Purpose Wide-Band Preamp

Boost any audio or RF signal from 50 Hz to 100 MHz.

by Dave Miller NZ9E

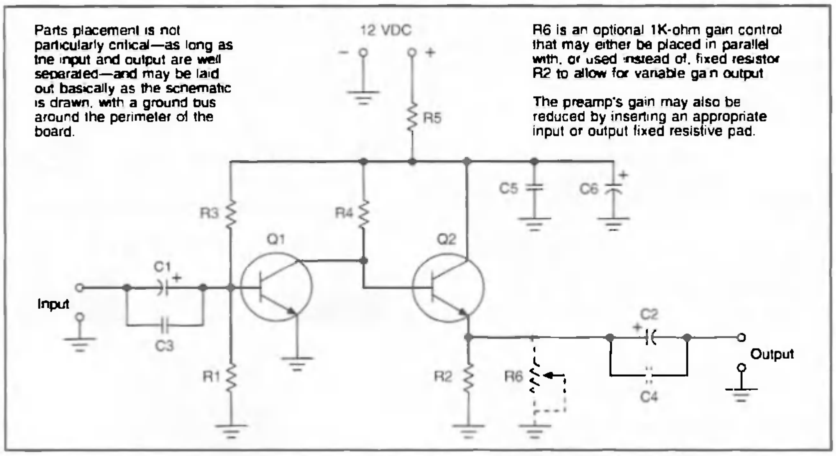


Figure 1. Wide-Band preamp.

Here's a handy audio/RF preamplifier that has many uses in and around the ham shack for generally boosting a low-level AF or RF signal. It can be used to provide greater input to a test instrument or for boosting a weak signal into an add-on peripheral. The beauty of this particular circuit is that it's easy to build, and has no coils to wind nor exotic parts to obtain. In fact, everything you'll need is available at your local Radio Shack, yet it will provide clean amplification from less than 50 Hz in the audio spectrum all the way up to over 100 MHz in the RF range. It's not intended for extremely low-noise preamplification, but it will do a reasonably good job in most applications where just some easily-supplied addi-

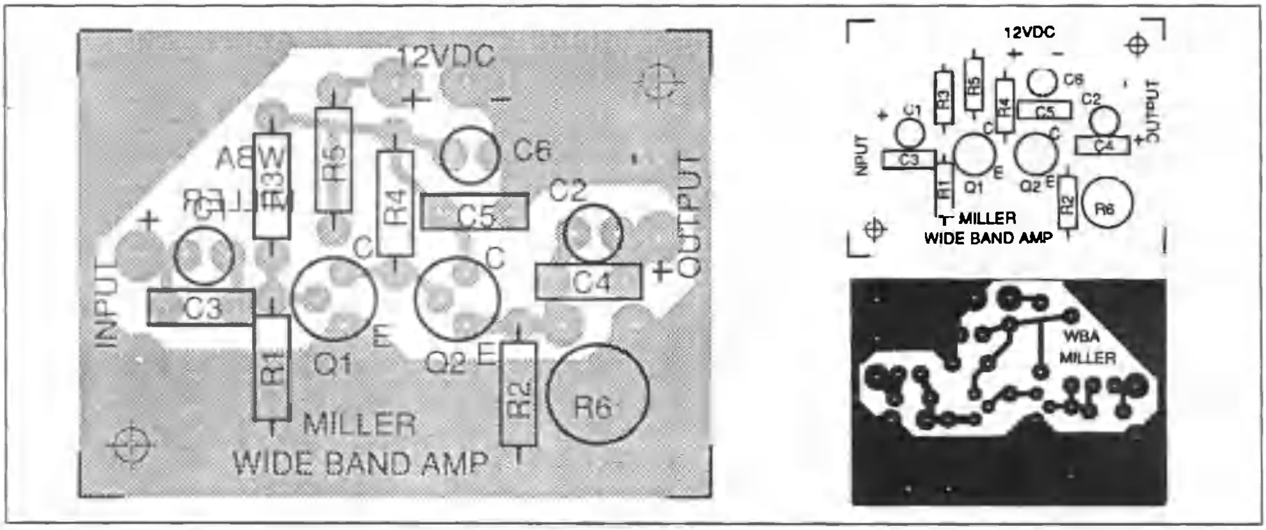


Figure 2. The preamp circuit board.

tional gain is needed. If you intend to use this circuit as a mike preamp around high RF power, some RFI-proofing (limiting the RF end of the response curve with ferrite beads and RF bypass capacitors) would be well advised.

Construction can be done on a perf board, keeping all leads as short as possible. The specifications and parts list are shown below.

Specifications

Usable frequency range: AF from 50 Hz to RF over 100 MHz, with a gain of +35dB at 100 kHz, +30dB at 10 MHz, and +17dB at 100 MHz. The noise is under 10 microvolts across 50 ohms (greater with a higher terminating impedance). The output is 100 millivolts or better into 50 ohms and 500 millivolts or better into 600 ohms.

The power supply requirements are 12–15 VDC at about 10 mA. The output begins to drop with less than a 12-V supply, and audio linearity begins to suffer below 10 V at maximum input. The input should be kept below about -30 dBm or 30 millivolts (.03 V rms). Noticable flattening of the waveform begins with inputs greater than about -20 dBm or 100 millivolts (0.1 V rms).

Parts placement is not particularly critical, as long as the input and output are well separated. It may be laid out basically, as the schematic diagram (see Figure 1) is drawn with a ground bus around the perimeter of the board. R6 is an optional 1k-gain control that may either be placed in parallel with, or used instead of, fixed resistor R2 to allow for variable gain output. You can also reduce the preamp's gain by inserting an appropriate input or output fixed resistive pad. ■

Parts List

Cl, 2	1-µF 35 V tantalum capacitors RS #272-1434
C3, 4, 5	.01 µF ceramic disc capacitors RS #272-131
C6	10-µF 35 V vertical electrolytic capacitor RS #272-1025
Q 1, 2	2N3904 transistors RS #276-2016
Rl	4.7k 1/4-watt RS #271-1330
R2	2.2k 1/4-watt RS #271-1325
R3	15k 1/4-watt RS #271-1337
R4, 5	330-ohm 1/4-watt RS #271-1315
R6	optional 1k micro-sized potentiometer RS #271-280
Misc.	perf board, bus wire, enclosure, input/output connectors, etc. as needed.

The circuit board is available from FAR Circuits, 18N640 Field Ct., Dundee, IL 60188, (708)-836-9148 voice or fax, for $3 each plus $1.50 shipping. Credit card orders over $20, or a $2 service charge for under that amount. You might as well build several of these handy preamps while you're at it anyway.

The Simple Simplex Repeater

An easily built project for interfacing with most transceivers

by Chris B. Sakkas KB8ITU

The Simple Simplex Repeater is a low-cost, easy-to-build project that, when interfaced with a transceiver, acts as a limited simplex repeater. Unlike most repeaters, a simplex repeater operates on a single frequency by recording the incoming transmission and playing back this recording on the same frequency. Operators who would otherwise not be able to contact each other directly can use a simplex repeater operated by another party to communicate. The Simple Simplex Repeater is handy in these situations and for use during emergency conditions.

The Simple Simplex Repeater is easy to interface to most transceivers, and can be built using readily available parts. Only three ICs and a handful of other components are needed to build the project. The core of the project is the ISD1000A Voice Record and Playback IC, available from Radio Shack, that stores up to 20 seconds of audio from an incoming transmission. When the incoming transmission has ended, the repeater keys the transceiver and plays the recorded transmission.

Design

Figure 1 shows the schematic diagram for the Simple Simplex Repeater. Point J1 is the input of the carrier-operated squelch (COS) signal from the radio. A received audio signal is said to be present when the COS signal is greater than 0.7 V, switching the collector of transistor Q2 to ground. The play/record (P/*R) pin of U1, the ISD1000A, then becomes low, placing U1 in record mode. NAND gates U3B and U3C are set up as inverters, and thus generate a high output. D flip-flop U4A is clocked on this positive edge, therefore making the Q output high. NAND gate U3A has both inputs high, therefore generating a low input to the power down (PD) pin of U1. The resistor R2 and capacitor C6 combination is used to generate a brief delay.

After COS drops below 0.7 V, the P/*R pin of U1 is made high, placing U1 in play mode. D flip-flop U4B is clocked on the positive edge, making the Q output high, which keys the PTT of the radio by switching transistor Q1. The R3-R4-C7 combination works as a negative-edge triggered negative pulse, which places the output of NAND gate U3A high for a brief period to allow U1 to enter playback mode.

When play is complete (or the audio memory is full), the end of message (*EOM) pin of U1 goes low. This clears U4A and U4B, allowing the PTT to be released and U1 to power down. The play sequence is entered if this state is created by a memory full condition after COS drops below 0.7 V.

Potentiometer R1 controls the volume of the audio out signal. A transformer can be used to match the output impedance to the radio, if desired.

U2 is a 5 V voltage regulator included in the design to allow connection to various unregulated DC supplies between the ranges of 7 V and 12 V. If, however, a regulated 5 V supply is used to provide power, U2 can be eliminated and the regulated supply can be connected to the V_{CC} points in the diagram.

Interfacing

The Simple Simplex Repeater can be interfaced easily to most radios. Six in-

Parts List for the Simple Simplex Repeater

Semiconductors
U1—ISD1000A Voice Record/Playback IC (RS 276-1325)
U2—7805 5 V voltage regulator
U3—74LS00 quad NAND gate IC
U4—74LS74 dual D flip-flop IC
Q1, Q2—2N3904 NPN transistors

Resistors
(All fixed resistors are 1/4-watt, 5% units)
R1—1K ohm potentiometer
R2—15K ohm
R3—1K ohm
R4—2.2K ohm
R5, R8—4.7K ohm
R6, R7—20K ohm

Capacitors
C1, C2, C3, C4, C5, C6—0.22-µF capacitor (RS 272-1070)
C7—220-µF electrolytic capacitor (RS 272-1029)

Additiional Parts and Materials
Connectors, solder, breadboarding material, power supply

Point	Description
J1—COS	Connect to carrier-operated squelch of radio. Must provide >0.7 V if a carrier is present, and <0.7 V if no carrier is present.
J2—V_{CC}	Unregulated DC input from 7 to 12 V.
J3—Audio Out	Connect to audio input of radio and adjust R1 to suitable volume level.
J4—PTT	Connect to push-to-talk of radio to control transmitting. This point is grounded to key the transmitter.
J5—Audio In	Connect to audio output of radio. The input impedance of this point is 2.7k ohm and the maximum drive level is 50 mV p-p.
J6—GND	Connect to ground of the radio.

Table 1. Interfacing Information.

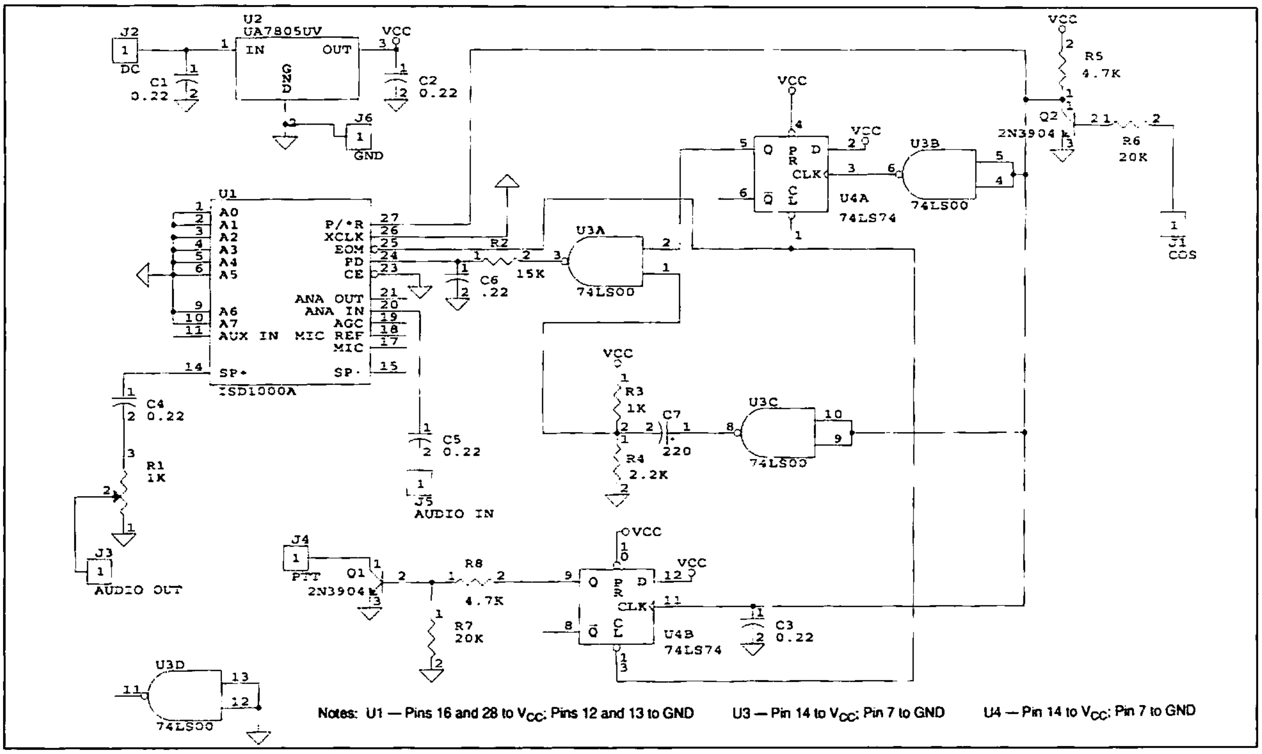


Figure 1. Schematic Diagram for the Simple Simplex Repeater.

put/output points are shown in Figure 1 for interfacing the Simple Simplex Repeater. Table 1 details the interfacing information needed for connecting the six input/output points to a radio. If your radio cannot be interfaced directly, a minimal amount of interfacing hardware is required to complete the interface.

Conclusion

The Simple Simplex Repeater is ready to be powered up and used! This inexpensive and easy-to-build project allows anyone to have a repeater readily available for emergency use.

Poor Man's Doppler

A Doppler system that's as "dumb" as a fox.

by Sam Guccione K3BYCC

In recent years, transmitter hunting has grown in popularity. Transmitter hunting, or fox hunting as it is sometimes called, is the original amateur radio athletic sport. Searching for an unknown transmitter by using your skill with electronic equipment, coupled with navigational techniques and athletics (you may have to walk or run around some), makes for an exciting and fun time. *73* magazine has a column devoted just to fox hunting called "Homing In," edited by master hunter Joe Moell KØOV.

After reading Joe's book[1] and columns in *73*, I have learned that one of the better methods of transmitter hunting at VHF and UHF frequencies is the Doppler. In a Doppler system, four antennas in a square array are electronically switched on and off in a rotating sequence. The signal received at each antenna is processed to determine the direction or bearing of the signal arriving at the array. In the presence of a strong clear signal without surrounding obstructions, the Doppler gives a true bearing. A popular Doppler design, The Roanoke Doppler[2], gives bearings to less than 22.5 degrees with a 16-LED display. When obstructions are present, multipath can occur that causes the display bearing to fluctuate around the true bearing. Using eyeball averaging, you can usually determine a consistent bearing even in multipath situations.

One of the biggest disadvantages of Doppler systems is the cost and the complexity of construction of the antenna array switching mechanism. A much simpler and cheaper direction finding system is the Homing kind. Two techniques are used in Homing DF units to get a direction. They are the time difference of arrival (TDOA) method[3] and the phase front detector.[4] The methods are similar and produce essentially the same result. The TDOA uses two antennas that are electronically switched back and forth. The antenna that is closest to the signal transmitter is the one that picks up the arriving signal first. An LED connected to that antenna will light up when this occurs. By manually rotating the two antennas together as a pair, you can find a bearing point where the LED on the first antenna goes out and the LED on the second antenna lights up. Rotating the antennas back slighdy will produce a cross-over point where neither LED is lit. This bearing angle, which is the broadside direction of the two antennas, is the exact bearing (to within a few degrees or less) to the fox transmitter referenced to the direction you are facing. The LEDs are usually marked left and right in a TDOA to indicate which side of the bearing line to the fox transmitter your antenna array is pointed.

The phase front detector processes the phase information from both antennas. If both antennas are exactly broadside to the signal bearing line, the phase for them will be the same and a null will be produced when they are compared. Rotating the antenna to the left or right will cause the phase to be different. This difference is sensed and displayed as a left indication or right indication.

The Homing DF units have the same problem with multipath as the Doppler. However, they are much cheaper and simpler to construct, including the antenna array, than the Doppler. After weighing the cost and construction complexity of these two methods, I chose to put a Homing DF system together. Not wanting to build a unit from scratch, I began looking for an inexpensive Homing DF kit. Fortunately, Ramsey Electronics had just such a kit: the "Fox Hound" Radio Direction Finder Kit Model DF-1. The DF-1 sells for $59.95, excluding a cabinet.

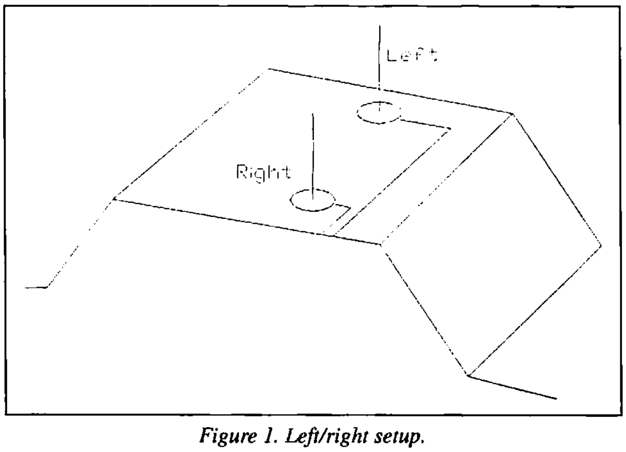


Figure 1. Left/right setup.

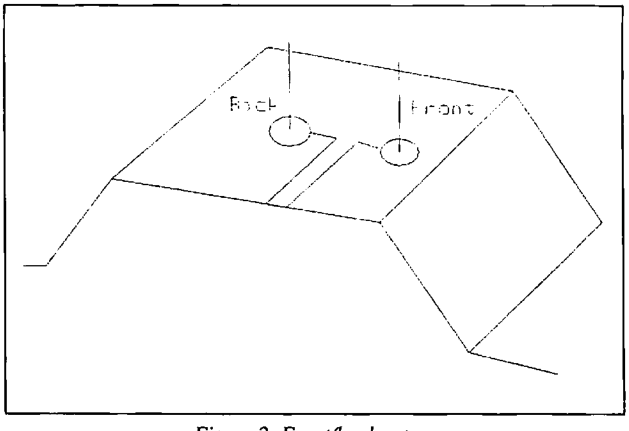


Figure 2. Front/back setup.

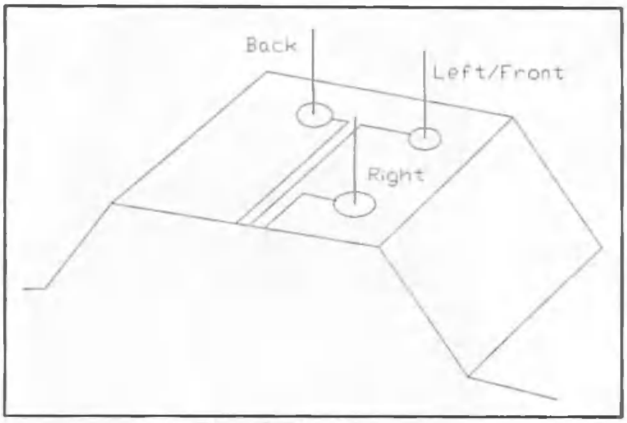


Figure 3. Triangular setup.

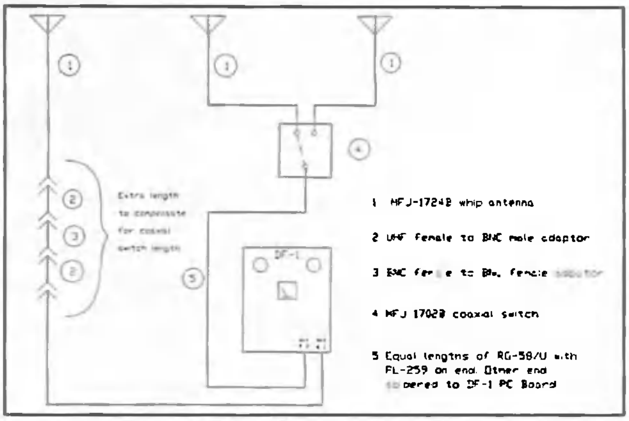


Figure 4. Triangular setup wiring diagram.

Stationary System

I quickly ordered a DF-1 kit. While waiting for the kit to arrive, I searched through my *73* magazines for a review of this kit. KØOV reviewed[5] the original kit and found problems with its revision 1 PC board. Ramsey has since upgraded the PC board. I had no difficulty with assembly including the antenna system construction. My kit, which had a revision 2.3 PC board, worked correctly and as advertised. The left/right indication was easy to follow on foot, except when significant multipath was present. I used eyeball averaging in those situations to establish a left or right direction. Installing the DF-1 in my car consisted of mounting a pole temporarily attached to the inside of my driver's side door. The window had to be rolled down to be able to rotate the antenna manually. I did this work in the winter months of 1994. While using the Ramsey during an especially cold day of fox hunting, I began to wonder about mounting the two antennas in a fixed arrangement on my car so that I could fox hunt with the windows rolled up. The fixed left/right arrangement shown in Figure 1 produces a bearing that points toward the front of the car. The LEDs give a left/right indication with respect to the direction the car is traveling. I had remembered one of KØOV's "Homing In" columns that described a Homing DF system with fixed antennas used by CAP hunters.[6] In reviewing that column, I found the CAP hunters had used permanently mounted whips on their vehicle.

I looked the Ramsey unit over carefully to see if it could be modified for fixed antennas. The DF-1 antenna array consists of two vertical dipoles that are connected to the unit's PC board by two equal lengths of coax soldered directly to this board. This arrangement seemed to lend itself to easy modification.

Fixed-Antenna Modification

Before making the modifications, I looked at different kinds of whips that might be used. Cost was a factor. I quickly settled on the MFJ-1724B whip. This antenna is a dual band magnetic mount whip (hey, maybe I could make this work on 440 as well) with 15 feet of coax, a PL-259 connector attached, and a bonus: a female UHF to male BNC adaptor as well.

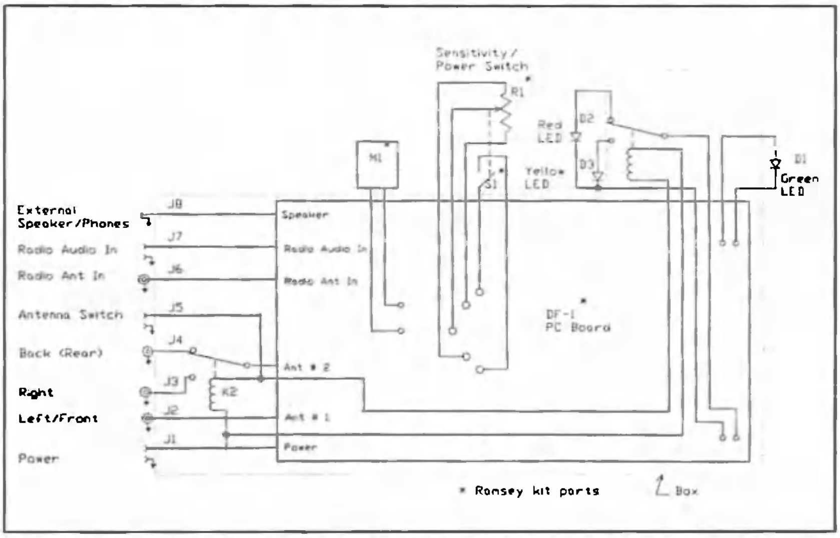


Figure 5. Repackaged DF-1 wiring diagram.

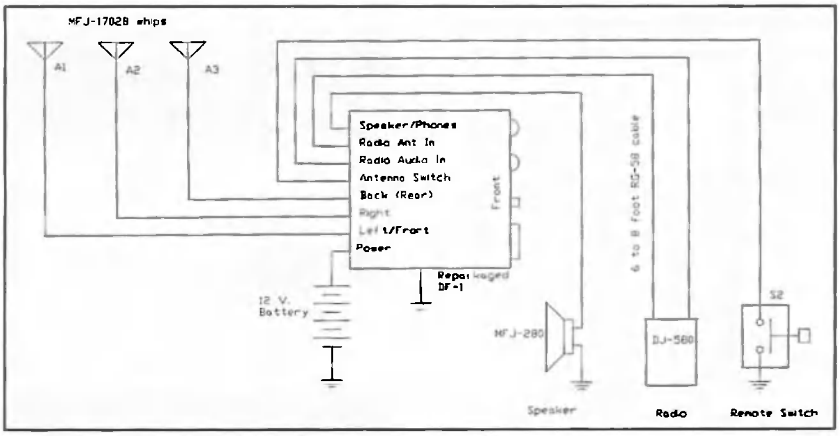


Figure 6. PMD wiring diagram.

All of this for less than $15.

To test the DF-1 with the MFJ whips, I removed the Ramsey antenna system and installed female BNC jacks to the PC board. I connected the MFJ whips to this modified board using the UHF to BNC adaptor supplied with the whip. I placed the whips on my car as shown in Figure 1. With this antenna configuration, the DF-1 LEDs indicate left/right directions. A lit left LED would indicate the fox transmitter was to the left of the direction in which I was driving. A lit right LED would indicate the fox transmitter was to the right of the direction in which I was traveling. If neither LED was lit, then I was travelling in the exact direction in which the fox transmitter was sending a signal. All I had to do to find a hidden transmitter was turn left or right, following the LEDs until I could line up my car on the exact bearing so that neither LED was lit. Unfortunately, this doesn't work in practice because highways and roads are seldom laid out to be in line with the signal direction of the hidden transmitters I was trying to find.

Parts List

Item	Description	
A1,A2,A3	Antenna Whip	MFJ-1724B*
B1	Speaker	MFJ-280*
M1	Meter**	
PC	Ramsey "Fox Hound" Direction Finding Kit	DF-1**
R1/S1B0	100 k ohm potentiometer with switch**	
D1	Green LED	276-022***
D2	Red LED	276-041***
D3	Yellow LED	276-021***
J1	DC power jack	274-1563 ***
J2,J3,J4	SO-239 chassis mount jack	278-201***
J5,J7	Panel mount phono jack	274-852***
J6	BNC chassis mount jack	278-105***
J8	Subminiature panel mount phone jack	274-251***
K1	12-volt relay	275-241***
K2	SPDT RF relay Omron G5Y-1-DC12	Z724-ND****
S2	SPST momentary push button switch	275-1556***
Box	3 1/16" x 8 1/4" x 6 1/8"	270-274 ***

4- to 5-foot hookup wire
2- to 3-foot RG-174 coax
6- to 8-foot RG-58 jumper cable with BNCs
3 snap-in LED holders
* Available from MFJ
** Part of Ramsey DF-1 kit
*** Available from Radio Shack
**** Available from Digi-Key

Front/back

While thinking about this problem, I tried moving the whips to a front/back setup shown in Figure 2. This worked just as well as the left/right setup.

In the front/back setup, I follow the LED connected to the front antenna until it goes out and the back LED lights up. I thus know that I have just crossed over a bearing line of the fox, and the transmitter is now behind me. I then make a right (or left) turn and note which LED is lit. If the back LED is still lit, I make a quick turn around and go the other direction; otherwise, I continue in this new direction. Once again, I follow the front LED. I repeat the above process until I am close enough to use my handheld with active attenuator or my sniffer unit.

Giving more thought to both the front/back and left/right setups, I decided to put four whips on the car and switch between the pairs. This would give me a four-direction indication. This setup is briefly described in Transmitter Hunting.[7] Two SPDT coaxial switches or a DPDT coaxial switch would be needed. Trying to keep this really simple, I figured that only three antennas and one SPDT coax switch could be used if I set up a triangular antenna array as shown in Figure 3. The whips were spaced about 18 inches apart—a quarter wave length. I used an MFJ-1702B coaxial switch to switch the right and back whips to form the left/right pair and the front/back pair. One whip functions as the left/front antenna. The wiring diagram for this configuration is shown in Figure 4. Several fox hunts confirmed that this system worked well except that the same pair of LEDs that indicated left/right were used for front/back. I got confused a few times because of this.

At this point, I decided to repackage the DF-1 to have separate pairs of LEDs for left/right and front/back, electrically switched antennas with the switch near the steering wheel, and a low profile so that it would sit on the dash just behind the steering wheel. I would not have to look down to see which LED was on and which position the coax switch was in. Even though this system does not work on the Doppler principle, I call this "A Poor Man's Doppler" because it is relatively cheap, easy to construct including the antenna array, uses a multiple antenna array sort of like a Doppler, and gives bearing directions in one of four directions using LEDs.

Poor Man's Doppler Construction

I recommend building the DF-1 according to the instructions supplied by

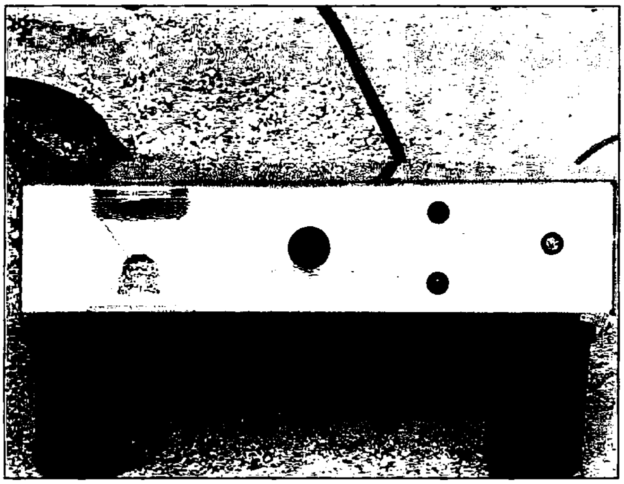


Photo A. Front view of PMD (all photographs courtesy of N3JGP).

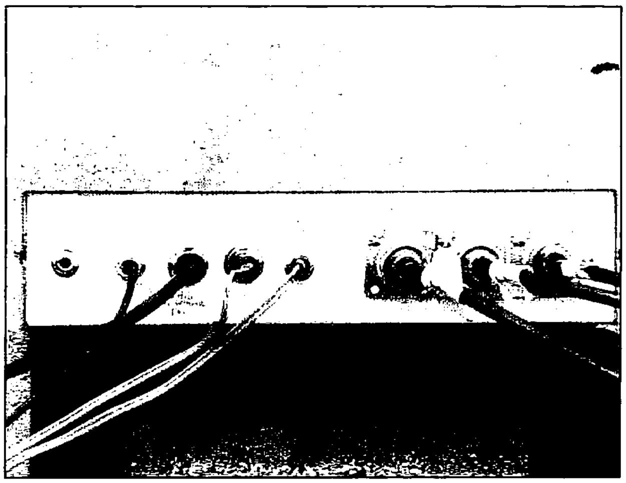


Photo B. Rear view of PMD.

Ramsey and testing it for correct operation before constructing a PMD. Figure 5 shows the wiring diagram of the repackaged DF-1, and Figure 6 shows the complete Poor Man's Doppler system wiring diagram. Table 1 shows the parts list. The three MFJ whips are used unmodified. I used a 6- to 8-foot jumper cable of RG-58 with BNC connectors to connect my handheld to the Antenna Input of the PMD. Also, I decided to use an external speaker, an MFJ-280, instead of building this into the box. I used manual electrical switching instead of automatic electronic switching so that I could choose to follow the front/back or left/right directions. The system is in the front/back mode until I push the remote switch button.

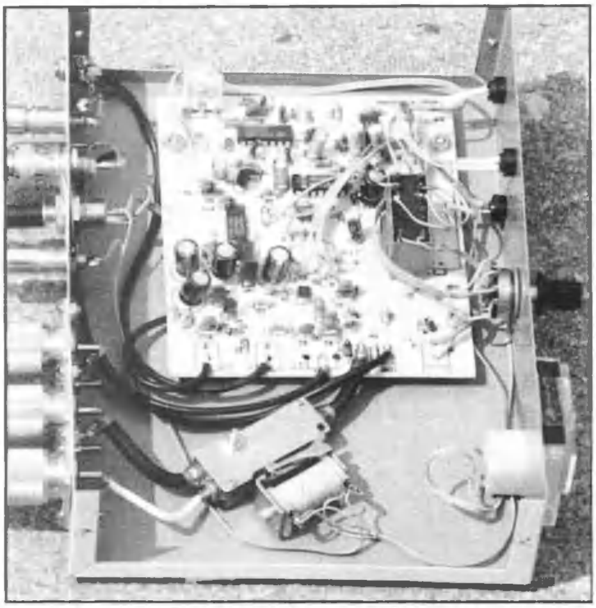


Photo C. Interior view of PMD.

The construction is straightforward. The only critical area is the coax cable lengths from the PC board antenna connections to the SO-239 antenna jacks. Use equal lengths of RG-174 from the RF relay K2 to jacks J3 and J4. Any length may be used from the relay to the antenna 2 input on the PC board. However, the length of RG-174 from J2 to antenna 1 input must be the same length as from J3 or J4 to antenna 2 input. Be sure to add a little bit for the length in the RF relay K2.

Photo A shows the front view of the PMD. I ended up using only three LEDs: a green one for the front/left direction, a red one for the back direction, and a yellow one for right. The bottom LED marked R in Photo A is the Red Rear or Back LED. The meter and sensitivity control/power switch are existing parts of the Ramsey kit. Photo B shows the rear view of my repackaged DF-1. The SO-239 marked Rear is the Back antenna input. Photo C shows the interior view of the repackaged DF-1. The DF-1 PC board is mounted on standoffs. The large object at the bottom of the box is a surplus coaxial relay that has been replaced by the Omron RF relay. The SPDT relay used to switch the LEDs is hot glued to the middle right side of the PC board. Photo D shows the three whip antennas in place on the author's car. The PMD

Photo D. PMD mounted on author's car.

box can just be seen behind the steering wheel. The barely visible string attached to the front/left antenna is used to set the correct spacing when placing the whips on the car roof.

Using the PMD

This is my technique for using the PMD. I get an initial compass bearing using a three-element beam and my handheld. I begin driving in the direction of the compass bearing using a dash-mounted car compass. I watch the front and back LEDs. Quite often they are alternately flashing, indicating multipath. I eyeball average to determine which LED is on most of the time, and try to keep the car heading in a direction so that the front (green) LED is mostly on. I periodically switch to the left/right to see which side the fox transmitter is located with respect to the track I am traveling.

I continue driving until the back (red) LED turns on. When this occurs, I know I have crossed over the bearing line of the transmitter signal. I quickly switch to the left/right antennas to see on which side of the car the signal is located. I turn in the direction indicated by which LED is lit, the left or right. I once again follow the front LED. I continue the above process until my sniffer, which I connect to an antenna before starting a hunt, sounds off.

440 Operation

Once I got the PMD working to my satisfaction on 2 meters, it was time to see if it would work on 440 MHz. My initial tests showed erratic indications. I decided the spacing needed to be much closer than 18 inches. Since a quarter-wavelength spacing is usually recommended for Homing DF units, I changed the antenna spacing to 6 inches and tried again. This produced mixed results. My next try was to replace the dual-band whip elements themselves with quarter-wave whip elements cut for 440 MHz. I constructed the 440 whip elements from 1-inch-long 3/8 x 24 bolts and 7-inch lengths of brass welding rod. I drilled a 1/4- to 1/2-inch deep hole in the top of each bolt to accept the welding rods, and soldered the rods in place. I replaced the dual band elements with the homemade 440 elements. An MFJ-219 440-MHz SWR meter was used to set the length to the resonant frequency that I wanted. I ended up with a length of 6-3/16 inches.

The unit immediately began to work except that the LED direction indications were completely reversed. That is, a fox transmitter on the left side of the car was causing the right LED to light. Similarly, a fox transmitter in front of the car caused the back LED to light. A 180 degree phase reversal had taken place. No provision is made in the DF-1 to compensate for phase reversal other than to reverse the antenna locations.

I reviewed the DF-1

schematic. The two phase signals that cause the LEDs to light are applied to the inputs of a quad XNOR chip. Reversing these two signals to the inputs of the XNOR should reverse the LED display. However, I have not tried this combination.

For the time being, I decided to use only two antennas on 440 and physically reverse their locations. I presently use the front/back pair that are swapped so that the back antenna is placed to the front of the car and the front antenna is placed in the rear. This swapping achieves a 180-degree phase shift that compensates for the 180-degree phase shift that occurs in the PMD. I hunt in this mode using the procedure I described in the front/back section. I have found that this is not as good nor as convenient as the full PMD, but it has allowed me to participate in 440 hunts. I plan to work on a phase switch of the signals sometime in the future. However, because I am having fun playing and using this present setup, these changes will have to wait for this coming winter.

Conclusion

Although the PMD does not give an exact bearing to the fox transmitter as does the Doppler, I have found it to be competitive in comparison to them and cheaper. Parts are readily available and construction is relatively easy. Let me know if you build one of these. I can be reached at sguccion@outland.dtcc.edu, on the fox-list USENET group.

References

1. Joseph Moell and Thomas Curlee, *Transmitter Hunting: Radio Direction Finding Simplified,* (TAB Books, 1987).
2. Joseph Moell and Thomas Curlee, *Transmitter Hunting: Radio Direction Finding Simplified*, TAB Books, 1987, Chapter 9.
3. Joseph Moell, "Winning Foxhunts with TDOA," *73 Amateur Radio Today,* November, 1989, pp. 52–53.
4. Russ Andrews K6BMG, "The inventor talks about the SuperDF," fox-list message dated 29 March 1995.
5. Joseph Moell, "Testing the Ramsey Foxhound," *73 Amateur Radio Today,* December, 1993, pp. 60–61.
6. Joseph Moell, "T-Hunters to the Rescue—RDF in the CAP," *73 Amateur Radio Today,* April, 1994, pp. 70–73.
7. Joseph Moell and Thomas Curlee, *Transmitter Hunting: Radio Direction Finding Simplified*, TAB Books, 1987, pp.104–106.

A Serial Port CW Terminal, or ROBO-COPY Revisited

Cure the itch for computer CW.

by Mike Aiello N2HTT

I have always had ambivalent feelings about the code. Its efficiency and simplicity are powerfully attractive, but my own lack of copying skill was frustrating. So when I saw Michael Hansen's article in *73* about his ROBO-COPY CW copier[1], I instantly knew this was a project I had to build. I was delighted with ROBO's performance. The simple audio interface and IBM-compatible software completely lived up to my expectations.

Human nature being what it is, however, it wasn't long before I began to feel the need for a fully functional CW terminal that could run on my PC. So, with the addition of transmitter-keying hardware and completely new software, the project evolved into a bidirectional serial port CW terminal, which I call the Serial CW Terminal, or SCW.

Keying Hardware

The standard PC RS-232 interface makes use of a UART (Universal Asynchronous Receiver/Transmitter) chip of the 8250/16450/16550 family. These chips allow software control of two output lines called DTR and RTS, either one of which could be used to key a transmitter for sending CW. Under software control, these lines may be asserted (set to a logical ON state) or dropped (set to logical OFF). My original thought was to toggle one of these lines connected through an opto-coupler to operate a simple keying circuit. The opto-coupler would provide good isolation between the expensive PC and whatever junk box components I used in the keyer. As it turned out, this simple solution was unworkable because of an unexpected problem.

The PC controls the UART's output lines by setting a register located on the UART chip. Once that register is set, it will retain its setting until the PC writes to it again or is shut down. Many common communication programs (serial mouse drivers, for example) assert the very lines I was considering for my keyer. Once set, they remain asserted after the software has finished executing on the PC. So there was a very good chance that the keyer circuit would see the serial port line asserted and go key down immediately as power was applied. This was an unacceptable flaw in the scheme, but happily there is a straightforward solution based on two facts:

1. Software that uses hardware handshaking (the serial port output lines) generally asserts two of the lines simultaneously: DTR and RTS.

2. Logic states on the RS-232 lines are represented as voltages of opposite polarity, roughly +/-9 volts.

In the keyer circuit shown in Figure 1, I arranged two opto-couplers with their outputs in series and their inputs connected with opposite polarity in regard to signal ground. With DTR connected to the positively oriented opto-coupler, and RTS to the negatively oriented, the output side will only conduct to ground when DTR is asserted and RTS is dropped. This configuration forms a "logic gate" that will key the transmitter only when the DTR high/RTS low combination is presented to it. A "truth table" for this circuit would look like this:

Transmitter Keying Based on RTS/DTR Logic States

	DTR ASSERTED	DTR DROPPED
RTS ASSERTED	UNKEYED	UNKEYED
RTS DROPPED	KEYED	UNKEYED

The normal rest state of the UART, where both lines are dropped, and the software-induced state, where both lines are asserted, are safe, as is the DTR low/RTS high combination (which I do not believe occurs in nature).

As neatly as all this worked out, in actual practice it proved not to be the whole solution. If I left the interface connected to the PC while it was booting, the mouse driver apparently cycled through the RTS-OFF DTR-ON condition, briefly keying the rig! The position of the power switch had no effect, since the keyer side of the circuit draws its power from the RS-232 lines and not the battery in the interface.

I wound up replacing the SPST power switch in the original interface with a DPDT. Half of this switch controls power to the receive side, and the other half, as shown in the circuit diagram, interrupts the output side of the keyer. With this modification, there is no way the PC can key the rig when the power switch is in the off position.

The resistors shown in the circuit are current limiters for the LED side of the opto-couplers. Signal diodes were added to combat one other problem: The opto-couplers I was able to obtain were only rated for a peak inverse voltage of 3 volts on the LED side. Since this is much less than the typical 9-volt swings of the RS-232 lines, I added the 1N914s. They have a PIV of about 60 volts and protect the opto-coupler's input. The output transistor in the 4N26 opto-coupler can sink about 300 mA. Solid-state rigs that use direct keying don't require any additional circuitry. In a situation where a higher current or voltage is present on the transmitter's key line, or if your rig requires grid

block keying, the appropriate relay or pass transistor could be added after the opto-coupler output.

Construction Techniques

As you can see from Photo A, the construction and parts layout are not terribly critical. In my prototype I used "dead bug" construction on one side of a piece of double-clad circuit board with excellent results. There is one thing to keep an eye on, though: the matter of grounds. There are four different circuit grounds that meet at the hardware interface: the signal and braid grounds of the RS-232 connection; the ground side of the audio in; and the ground side of the transmitter key line. In order to minimize noise, interference, and potential ground loops, all of these grounds are isolated in the interface. If you look closely at the photograph, you may be able to see where I cut gaps in the foil to isolate the circuit ground plane from the metal box (look where the screws go through the board at the corners). Less obvious is the use of insulated binding posts for the key line to the transmitter; both sides are isolated from the box. It is of particular importance that the only ground to be connected to the circuit itself is the signal ground from the RS-232 line (pin 7 of the 25-pin connector, or pin 5 of the 9-pin connector.)

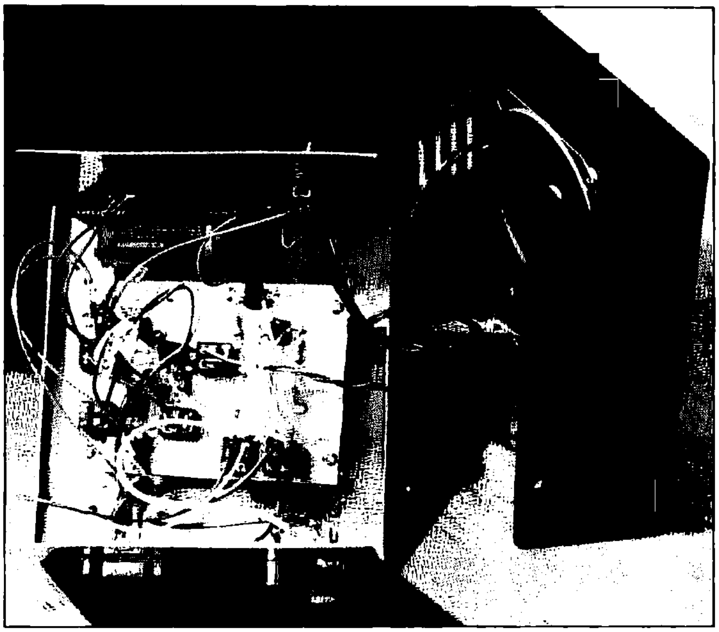


Photo A. The serial port CW terminal.

SCW Software

SCW is a completely new software package that provides receive-only capability with unmodified ROBO-COPY interfaces, and is a full featured bidirectional CW terminal with the addition of the keyer circuit described above. Although SCW offers some of the same user features as ROBO-COPY, its internal architecture is different and this allows for some intriguing extended capabilities.

Like ROBO-COPY, SCW uses the UART to provide the basic timing of the CW send and receive, thus making it usable on machines of any speed and vintage in the IBM-compatible family, from 8088s to 486s.

SCW's receive logic differs from ROBO-COPY in that the decoding algorithm is not statistical in nature, but rather makes use of heuristics or decision rules to accomplish the decoding. The most noticeable consequence of this difference is the lack of any user-adjustable CW timing parameters; they are not needed. Like ROBO-COPY, SCW does offer a noise filter feature that is user adjustable. This feature requires audio tones to persist for a certain minimum duration before SCW accepts them as Morse dits or dahs. As the minimum pulse width is increased, the system becomes more noise immune, but the maximum code speed that can be decoded is reduced.

Program Feature

SCW provides a split-screen user interface that displays received text in its upper portion, and transmitted text in the lower. The upper window displays the complete set of Morse characters, including prosigns. You may elect to have SCW display prosigns as character pairs in reverse video, or as special characters. Dot-dash combinations that SCW does not recognize are displayed as the tilde character (~).

The lower window is also shared by the program help screen and several user dialogs. The bottom of the screen displays the current program status, and a function key prompt bar. In the default mode transmitted text may be entered and edited while the program is receiving, and is sent only when the return key is pressed.

SCW allows full break-in operation (QSK, or full duplex); however, if your rig produces an audio side tone that cannot be switched off, you can suppress receive during send to avoid echoing your transmitted code in the receive window.

You can control most of the important program functions with the function keys. Repeated presses of the F8 key cycle the send function through buffered mode, direct mode, and complete shut-off. F9 toggles the receive function on and off. Many less frequently used program functions are activated via ALT key combinations, and pressing F1 displays a concise summary of all the keys SCW recognizes.

Two very handy features included in SCW are file capture and the ability to define keystroke-send macros. File cap-

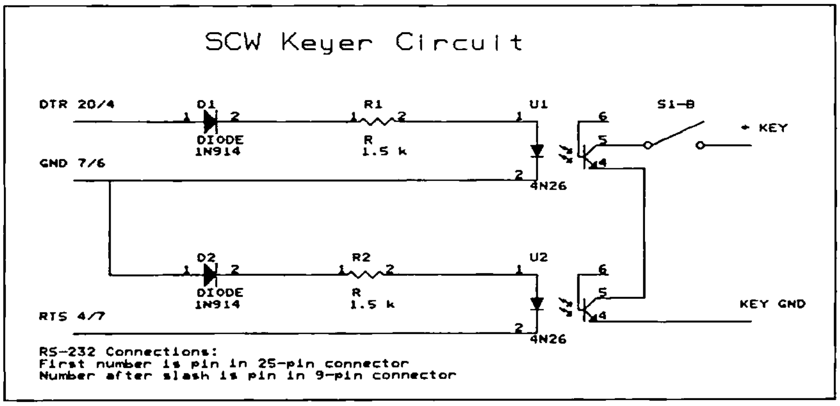


Figure 1. SCW keyer circuit.

ture may be turned on or off at any time and captures the received text into an ASCII text file. The macro feature allows you to create one macro of up to 255 characters in length for each of the ALT-number keys. You can create or edit macros at any time, and by pressing the ALT-number key you can add the macro's text to the current send window.

Perhaps the most intriguing feature of SCW is its self-synchronizing ability. SCW can detect when it has lost its lock on an incoming CW signal. When this occurs, SCW displays a graphic character—a gray box the height of the line—to indicate that it is resynchronizing. Within a few characters SCW will once again be locked in on the signal. There are several things that can cause a loss of synchronization; QSB and isolated static or noise bursts are the most common. SCW fares least well in heavy QRM conditions, as it cannot distinguish signals by their audio pitch.

Availability

SCW is available at no charge for noncommercial use directly from me via mail for $5.00 to cover the cost of diskette, packaging, and postage. The SCW package includes the SCW terminal program (which can run using COM1 or COM2) and a brief documentation file, packaged together in a self-extracting compressed file.

I'd like to thank Michael Hansen WB9DYI for his excellent work in developing the ROBO-COPY interface, without which I would never have undertaken this project, and my good friends Matty Mozzor N2IMZ and Gordon Horn W2WTV for their encouragement and insightful critiques of the SCW software. Special thanks also to Dan Iancu for his invaluable help with the keying circuit.

Mike Aiello N2HTT, Box 195, Pleasantville, NY 10570.

References

1. Michael Hansen, "ROBO-COPY," *73 Amateur Radio Today*, October 1990, p28.

2. SCW software available on 3 1/2" diskette from Cortlandt Technologies, P.O. Box 195, Pleasantville NY 10570, for $5.00 postpaid.

Parts List

R1, R2	1.5k-ohm resistors
D1, D2	1N914 signal diodes
U1, U2	4N26 phototransistor opto-couplers
S1b	one side of DPST switch

73 Review

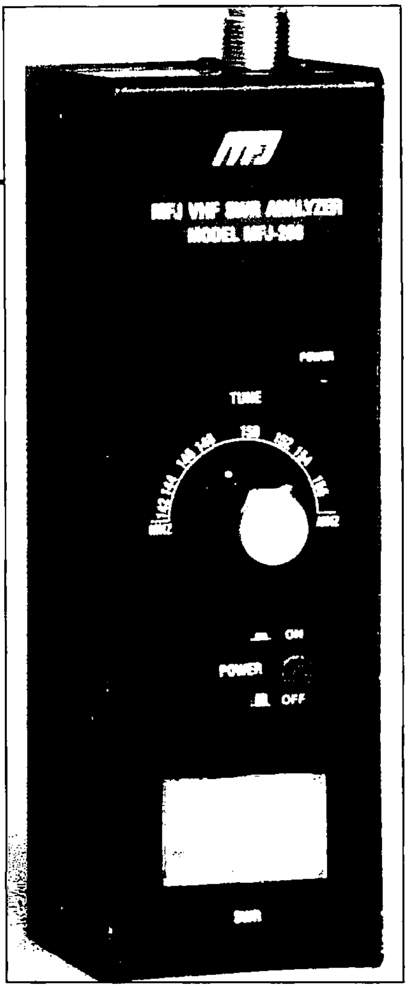
Number 13 on your Feedback card

by Breckinridge S. Smith K4CHE

MFJ Enterprises, Inc.
Box 494
Mississippi State, MS 39762
Price Class: $79.95

The MFJ-208 2 meter SWR Analyzer™

Cheap, easy to use, and it works!



I like test equipment. No, let me rephrase that—I am obsessed with test equipment. I want one of everything. Ask my wife; she will tell you. My collection started 40 years ago with a Heath meter; and now I have a shop full of everything. Anyway, the MFJ-208 2 meter SWR Analyzer™ is now part of my collection. I was a little skeptical at first due to the price of the unit, but I might as well tell you right now that the unit works and performs very well.

Your days of using your HT or base station rig running through an SWR bridge of questionable VHF performance into an unknown and sometimes hostile load are over. Admit it! How many times have you taken that CB SWR bridge and tried to use it on two meters? With the newer radios, if the antenna load under test isn't reasonable and close to 50 ohms when you first start testing, then the radio starts to shut down so you don't know where you are. Solution: just hook up this MFJ Analyzer and let it be your transmitter and SWR bridge combined. Just let her rip—no strain on your equipment, and you get the job done without hauling all that stuff out to the back yard.

Bench testing and a peek inside

As I passed through the kitchen with the analyzer on the way down to my shop, my wife asked me what the small box was. I told her it was spare parts—that always works. Safely downstairs in my shop, I removed the sheet metal screws, opened the unit up, and installed the 9-volt battery. I then pushed the switch and got a red LED. Carefully tuning the analyzer across the two meter band produced a strange buzzing sound from a nearby receiver. Yes, it's working, or at least it's oscillating on the two-meter band, I thought. A quick check on a dummy load confirmed it. I got a nominal SWR. Well, that figures. I checked one of my two meter beams and it showed some reflected power, but very little.

The unit uses a double-sided printed circuit board with professional traces. Attached to the board are the air variable capacitor and the meter. An LM324 operational amplifier IC was mounted in a socket for easy replacement, if necessary. The unit can be powered by a single 9-volt battery, or the MFJ-1312 power supply adapter. When installing the 9-volt battery, the manual cautions you to tuck the battery snap wires out of the way so that they do not interfere with the tuning capacitor rotation. This capacitor is a pretty good size air variable with moving plates mounted to a shaft, so heed their caution.

Checking the current drain from the 9-volt battery, I found that it was only 45 milliamps. The unit displayed a clean signal on my spectrum analyzer, and an output level of approximately 3 milliwatts. With this much output, MFJ cautions that damage to some radios may occur with a direct connection. In other words, don't hook this analyzer up directly to your HT. Moreover, don't transmit into the analyzer. I hooked the analyzer up to an external antenna to see if I could hit a nearby repeater. Buzz-kerchunk, no problem, as I carefully tuned through the repeater input. I then identified my mysterious transmission using my shop radio.

As MFJ does not supply a schematic, I wrote Stan Kozlowitz AA5XO at MFJ and asked him for a diagram. He promptly sent it to me but asked me not to publish it. Basically, the circuit is a VHF oscillator modulated by a low-frequency tone of approximately 170 Hz. Measuring the FM deviation on the service monitor in the FM mode resulted in a total deviation of approximately 12 Hz, so it will really buzz your receiver. According to Stan, the oscillator of the analyzer feeds a very sensitive Wheatstone bridge with a meter across the bridge. MFJ has an operational amplifier in the circuit to improve the sensitivity of the meter and they use an op-amp circuit across the output to measure the voltage to determine resistance.

The manual states that the unit will cover from 142 to 156 MHz. In addition, MFJ states that the dial calibration is approximate. On the unit I tested I found the calibration to be very close when the knob was centered underneath the dial frequency numbers, which were every 2 MHz. The unit actually transmitted from 137 MHz to 157.9 MHz. During my testing I performed actual SWR checks in the 2 meter band and at 151 MHz. MFJ provides an RCA phono jack on the unit so that you can connect the unit to a frequency counter. I had no problems in driving any of my counters, including some of my older equipment.

I then made some test resistor loads using a 47-ohm, a 100-ohm, and a 150-ohm resistor. The SWR measurements made with the analyzer were plenty close enough for amateur use.

Backyard Testing

Testing the unit in my backyard antenna range produced immediate results and was very enjoyable. Tuning up a home-brew four-element quad with a gamma match was a snap. I just wiggled the adjustments on the gamma match and then stood back and measured the SWR. When I got to a minimum reading, I quit. I didn't have a fre-

quency counter handy, so I used my handheld as a reference. Since the tuning on the analyzer is very sensitive, it is very hard to arrive at the exact frequency when using an HT. As you sweep through the target frequency, the S-meter will respond, even if you don't hear the signal. If you get a response on the S-meter, you are probably close enough. I also used the analyzer as a signal generator and stuck it out in a field. Due to the high output power, I used a small resistor load as an antenna. I then rotated my test antenna and watched the S-meter on my receiver to check for front-to-back ratio. It's a great little signal generator for testing your antennas.

I Was Hooked

After testing my quad, I then tested several commercial 5/8-wave antennas on my car. I then trimmed a mag mount 5/8-wave and a quarter-wave. Great!—this process is fast. I pulled down a couple of my commercial beams and touched them up. I am really getting the SWR fever now. Got to get those SWRs down on everything. On one job I took the analyzer up the tower and hooked it directly to a commercial antenna that was on 151 MHz. This provided a quick check of the antenna.

MFJ manufactures a commercial version of the analyzer that covers 150 to 170 MHz, and they also have other units including a 30 to 50 MHz model which I hope will cover the bottom end of six meters.

Testing Techniques

Next, I put together a quick 3-element home-brew beam with fixed capacitance coupling to be used for foxhunting. The only tuning was by trimming the driven element. Tuning the driven element on this beam was quick and easy using the analyzer. It only took about 5 minutes. MFJ mentions in their manual that when you are testing a new antenna, you should start with the driven element a little too long and then shorten it to resonance.

The MFJ manual includes a nice frequency vs. SWR chart for plotting your antenna response curve to show your buddies.

Then, I made a loop antenna for two meter foxhunting. If you have ever tried to tune one of these up you know how difficult it can be. I hooked up the analyzer, tweaked the variable capacitor on the loop antenna for minimum SWR and tested the antenna. It worked and had a nice null with good side lobes.

Overall, I liked the unit, and I liked the price and the construction. It's self-contained and easy to use. It will encourage you to experiment with home-brew antenna projects and to touch up your store-bought commercial beams. You no longer need to haul all that testing stuff out to the backyard. Just grab the "box" and start testing. Have fun.

73 Review

Number 14 on your Feedback card

by Gordon West WB6NOA

Alinco Electronics
438 Anapola Avenue
Torrance CA 90501
(310) 618-8616
Suggested Price: $1,399.95

Alinco DX-70 HF/6m Transceiver Surprises Everyone

Elegant and wide functioning with many conveniences for a good price.

Alinco Electronics, Inc., located in Torrance, California, is best known for its single- and dual-band VHF/UHF handheld and mobile transceiver equipment, sold by over 80 amateur radio dealers throughout the United States. Certain Alinco radios have achieved "fan club" status because of their unique design and relatively low cost.

Some Alinco Products

For instance, there are the Alinco 1200TH2 9,600 baud packet radio made popular by Buck Rogers packet column; the Alinco DJ-G1T, the first handheld ever with spectral channel-occupancy bar graph; and the Alinco DR-599 dual-band mobile with "secret" antenna jack for public safety 800–950 MHz.

While Alinco Electronics, Inc., does not possess the sales volume and market share that Kenwood, Yaesu, and ICOM have, the company does enjoy a reputation for well-performing VHF/ UHF equipment at prices slightly lower than the big three, and a small but efficient service team who can turn around most repairs at the Torrance facility within 10 working days. Alinco's technician/ engineer Taka Nakayama AB6VE, is extremely active on the ham bands, and knows the equipment inside and out. "I love operating ham radio," comments Taka. "When it comes to 9,600 baud packet, cross-band duplexing, or driving in downtown areas where intermodulation is a problem, I know how well our Alinco radios work because I'm active on the air," says Nakayama with a smile. He holds an Extra class United States amateur license and a Japanese license, too.

But Alinco Electronics really surprised the amateur radio community by coming out with a high-frequency transceiver for the 1995 Dayton HamVention debut. "First we have VHF/UHF, and now we have high frequency, too," comments Alinco Electronics USA President Mark Morisato KC6OCX. "And our new high-frequency DX-70 does more!" adds Morisato. No doubt Mark is speaking of the built-in, all-mode, 6 meter, 50–54 MHz capabilities with 10 watts output that is included in the high-frequency package and is the same size as the very popular and successful Kenwood TS-50 mobile HF transceiver.

Photo A. The Alinco DX-70 and the matching Alinco Antenna Tuner combine to form a compact "field" radio.

DX-70 Features

The new Alinco DX-70 HF plus 50 MHz all-mode transceiver runs 100 watts out from 1.8 MHz to 28 MHz on ham bands, and tunes 150 kHz to 30 MHz continuously from its excellent general coverage receiver. Plus, it covers 50–54 MHz, with all modes, and 10 watts out. That's plenty of soup to kick a 6 meter power amplifier into "QRO".

Most unique is the detachable control head that allows the new Alinco DX-70 to be separated so the head could go on the dash, and the transceiver under the seat. The mike still plugs into the transceiver body, so separating the two won't be a trunk-and-dash affair. But I don't recommend trunk mounting of any remote-control transceiver because of the long run of the DC power cable. This is just asking for trouble. If you want a longer mike cord, they have an EDS-5 microphone extension cable that will handle the job nicely. Keep in mind that the extension cable will cost extra—probably about $40—so if you plan to run it remote, factor this in to the transceiver's street price, which will probably

be around $1,250.

Yes, 6 meter fans, there is a separate output SO-239 antenna jack. When you switch to the 6 meter mode, you can hear several relays "go klink," which sound tells you they are running an independent receiver and transmitter section for best performance on the 6 meter band.

I hooked the DX-70 to a three-element HF beam and regulated 12-volt power source, with the 6 meter side over to a three-element 6 meter beam to see how the radio would perform in the real world. The display popped up with a bold numerical readout of frequency: MHz, kHz, and hundredths. The numbers are slightly smaller than the Kenwood TS-50, but are much bolder, wider, and darker. And like the Kenwood TS-50, there is a "busy" icon when the squelch is open, along with an amber jewel LED that also lights up with receive activity. The mode indicator appears in the upper right-hand corner, and AGC fast or slow appears above the frequency display. Finally, the DX-70 has more than enough to drive the top-mounted speaker.

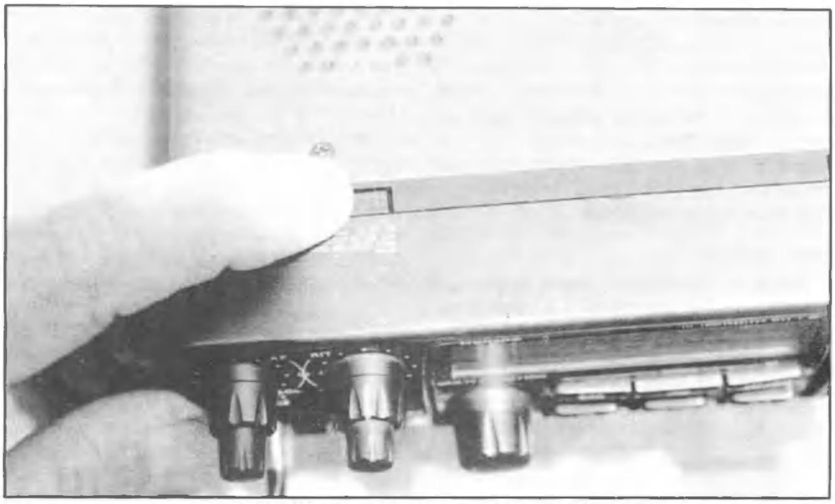


Photo B. Two "open" sliders clamp on the head.

Photo C. The head detaches in 3 seconds for purposes of security.

The Receiver

As soon as I hooked into the three-element tribander, there was no mistaking that the Alinco DX-70 has a wonderful receiver. It is dual conversion, with sensitivity and selectivity numbers identical to what you might find on everyone's sales brochures for a $1,000 HF mobile SSB transceiver. But unique with the Alinco DX-70 is the bottom left RF button that lets you switch in the 10 dB pre-amp, switch it out, or switch in -10 dB and -20 dB attenuation. I found that the attenuator was a big help when operating on 40 meters, with a neighbor one block away just 75 kHz up the band. On 10 and 15 meters I switched the pre-amp on, which gave me a hot receiver.

The same button that controls the RF gain selection also has a subfunction: it turns the noise blanker on and off. While the noise blanker does not have any timing or sensitivity adjustments, it did a nice job of killing the clatter of our next door neighbor's old Ford Thunderbird when he fired up the engine. Furthermore, the noise blanker did not garble on extremely strong signals. On many HF transceivers, engaging the noise blanker on 40 and 80 meters causes most signals over S9 to become garbled. Not so with this noise blanker.

Selectivity on SSB is 2.4 kHz, and a convenient "filter" button next to the RF gain button allows you to kick in the 1-kHz SSB filter. The 1-kHz filter is already built in, and not an added option for tightening up on an incoming weak signal. You can further home in on an elusive signal by rotating the IF shift knob to dodge the QRM. This same filter network offers 1-kHz or 1/2-kHz CW passband. And if you're into shortwave listening, you can click in 2.4 kHz AM narrow, or 9 kHz AM wide—including FM—for full fidelity reception.

The first IF is at 71.75 MHz, the second IF at 455 kHz, and spurious/image rejection is listed as 70 dB. When I switched back and forth between several transceivers on the bench, the Alinco was more sensitive and just as selective as the higher-priced sets.

Everyone commented on the recovered audio on SSB as being "sharp." It's the same-sounding audio I have heard from the Yaesu 900: impressive, full-fidelity treble without tightness or hiss. Listening to the DX-70, when tuned into a transmitting SSB station, is similar to hearing a hi-fi with bass, mid-range, and tweeters as opposed to an audio system with just a mid-range speaker. It's difficult to describe; try to listen for yourself.

"As soon as I hooked into the three-element tribander, there was no mistaking that the Alinco DX-70 has a wonderful receiver."

The AGC is a function/AGC command on the same push button as the filter switch. The function button is conveniently located to the left of the set, a natural arrangement for depressing it with your thumb, while using your forefinger for the other button.

I switched up to 6 meters to confirm that all filters, noise blankers, AGC actions, and pre-amps weren't the same. I did notice on a big 6 meter antenna that 10 dB of pre-amp gain brought in a phantom sound of an FM or TV station way in the background that could never be tuned in, but didn't have that problem with the pre-amp turned on when we tested the unit on the mobile 54-inch whip.

I also tested the Alinco 6 meter receiver performance against two other time-tested rigs and found the Alinco actually hotter on

receive with the pre-amp clicked on than the other two units, which were running with external amplifiers. And since the other two ran only 10 watts out, I didn't find 10 watts from this Alinco to be out of line. Mirage, now sold by MFJ, offers a 10-watt in, 150-watt output, 6 meter amp that I've seen selling for under $350, so getting more power from the Alinco package is not all that difficult.

Fine Tuning

The front panel of the Alinco features a main tuning dial along with a smaller tuning dial. The smaller dial is rotated for both memory channel select and megahertz or ham band select, and to change frequencies in specific kilohertz steps like 2.5 kHz, 1 kHz, or 500 Hz. This sub-knob reminds me of the "click-click-click" knob on the Kenwood TS-140. It's a handy feature. The main tuning knob resolves frequency down to 100 Hz (.1 kHz) dial indication, in 25-Hz steps if you ever-so-carefully turn the big knob.

The multifunction knob lets you quickly rotate through 100 memory channel locations that hold a surprising amount of memo-channel information: Receive frequency, mode, any split TX, filter, AGC setting, RF-gain amps or attenuators, noise blanker on or off. This is a very smart memory that might allow you independently to select a CW frequency for fast AGC, narrow filter, no-noise blanker, and RF pre-amp. On an SSB channel, you could memorize slow AGC, noise blanker, -10 dB attenuator, and the normal filter. I considered this versatile memory capability as a definite plus for this very compact rig.

Another nice feature is the high/low power output button. Unlike a slide switch or no power option at all, you can quickly reduce power to local stations or reduce the current consumption of the radio on a dying storage battery.

A dial lock key prevents you from accidentally turning the big knob when tuning channels in from memory. As in Icom transceivers, memory positions allow for instant QSY from the big knob. This allows you to use the small memo knob to get you within a pre-set spot on the dial, and then use the big frequency knob. A quick flick of the small knob instantly puts you back to that original memory position. And when operating from the memory position for the digital modes, you would lock (electronically) the big knob to insure you don't accidentally bump off frequency.

Other buttons and knobs on the front are the RIT capabilities; the "MF SEL" button to select memo, band, or frequency options; the little TX jewel LED that comes on for transmit; delta transmit; memory to permanent VFO selection; memory right, split, and priority—all the usual knobs on a HF transceiver.

If you press and hold the function key twice for longer than 2 seconds, "SE" will appear on the screen indicating you have set the Alinco DX-70 into the set mode. This procedure is similar to that of the Kenwood TS-50 in the "menu" mode. The small multifunction dial selects the many setup options.

The relatively large Alinco DX-70 instruction manual also describes procedures regarding simply resetting the mode settings, resetting all memory channels or VFOs, or performing a major reset of everything as if you had just purchased the equipment new from the dealer.

"It has been many years since I have seen the high-frequency transceiver manufactured with VHF and UHF bands included."

Connections

On the back of the transceiver are the customary jacks for speaker or headphones, featuring the common miniature jack (not subminiature). There is the common CW jack for connecting a telegraph key or electronic keyer system. It lacks a built-in electronic keyer, but most hams prefer their own style of electronic keyer rather than any type of built-in keyer The CW key-jack is also a miniature jack, not the big 1/4-inch jack you would find on larger equipment.

There are also RCA jacks for ALC as well as relay. When the equipment is new out of the box, the relay is out of circuit. Cutting an obvious internal jumper wire, detailed in the instruction manual, lets the relay close when the microphone or key is depressed. The ALC input voltage from the amp needs to be zero to -3 VDC.

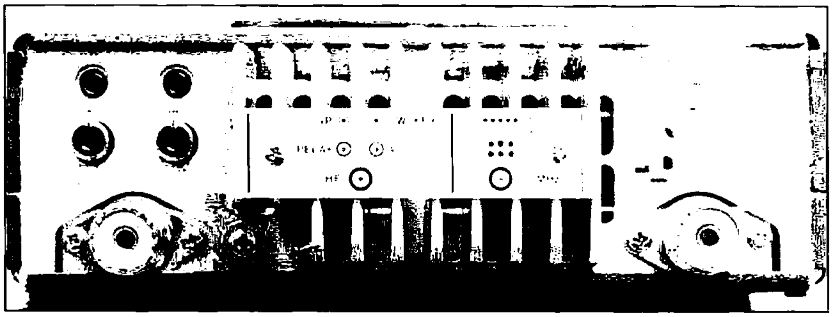


Photo D. On the rear of the DX-70 are two antenna jacks to the left for 3–30 MHz, and to the right for 50–54 MHz. It has the same power plug as all other brands of HF ham sets.

There is a small screw for connecting a ground foil tab, two antenna jacks plainly marked for HF and 6 meters, the heat sink, and then the power connector. More good news: It's the common six-pin power plug that is used by Kenwood, Yaesu, and ICOM from a DC source.

There is an external antenna tuner connection that the manual fully describes as being compatible with a Kenwood AT-50, a Kenwood AT-300, an Icom AH-3, or even an SGC 230 automatic long-wire antenna tuner for field day/maritime mobile/mobile home applications.

While I didn't see an accessory jack for going digital, the microphone offers pin 6 as the detector output with associated pins for PTT, ground, mike ground, and 5 volts DC. Taka at Alinco, an avid HF digital operator, says this radio has full capabilities in the digital modes.

Power Output

Power output on high frequency was a good 100 watts, and I noticed the average modulation level around 60 watts, indicating only slight ALC action. This gave me a good punchy signal that everybody commented about as being "hefty" and sounding great. An SWR protection circuit throttles back output down to 25 watts with no antenna, and a momentary antenna short-out pulled the power down to a safe 5-watt level.

On 10 meters FM, power output was also 100 watts. This surprised me because throughout the bands AM was only 50 watts. On 6 meters, the power output was 15 watts SSB, 11 watts FM, and 6 watts AM.

I then tried operating on 10 meter and 6 meter repeaters, and everything was going along fine in entering the 10 meter 100-kHz offsets as well as the 6 meter 500-kHz offsets. But where, oh, where was the almost-always-necessary CTCSS selections out of menu? Not there! What? No subaudible tone encode? Oh yes, there is, but it uses dip-switch programming.

The CTCSS encode is on the bottom side of the transceiver, with no mention of it in the well-written and illustrated instruction manual. The tone board is already installed, included with the package, but you need your trusty toothpick and penlight to manipulate the eight different switches for any *one* of 38 possible subaudible tones. But besides that, I enjoyed operating the equipment. The only thing I couldn't figure out when running the unit and not reading the instruction manual was how to get it to go into the set mode. As soon as I cracked the books, it was right there.

It has been many years since I have seen the high-frequency transceiver manufactured with VHF and UHF bands included. When you get a chance, head on down to your local amateur radio dealer and take a listen to the sharp high-fidelity action on the new Alinco HF + 6 meter transceiver that has a very bright future. 73

Number 15 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Get Loud!

You hear it all the time in ham publications: don't buy an HF amplifier, just get a better antenna or raise the one you have up higher. It's basically good advice, but it doesn't always work, does it? Depending on your location, surrounding mountains, sunspot activity, QRM, QRN, and whatever, you can find yourself unable to be heard, no matter what you stick up in the air. Or, you may not be allowed to have a tower . . . or you may not be able to afford one. Whatever the reason, sometimes increasing your output power is your only choice.

So, let's look at HF linear amplifiers. How to buy one, how they work, how you use them, how you don't use them, and how to best make use of the hot, glowing buggers.

Enduring Technology

I usually stay away from this subject, because I consider myself a transistor guy, and the vast majority of amps are tube-based. But, having just bought an amp at a local hamfest, I've had to take a look at the whole topic.

Yes, there are some solid-state HF linear amps, but they're quite expensive and relatively uncommon. For the most part, amplifiers haven't changed much in about 30 years! That isn't from lack of interest on the part of the manufacturers; there just isn't that much you can do to such a simple beast. Probably the biggest innovation has been the no-tune amp, but even that never really caught on in a big way. I don't know why it has remained obscure, but intuition suggests that such a design would be significantly less efficient than one with a nice, high-Q, tunable tank circuit. Another step forward has been the use of microprocessor control. Now there's an odd match, huh? Microprocessors and vacuum tubes. Actually, using a micro to control and store tuning settings is a good idea which makes amplifier use much more convenient and lets you have the best of both worlds: a high-Q tank and freedom from the manual tune-up process. So far, though, such fancy stuff is limited to rather expensive, high-end gear.

Something Old, Something New

So, should you buy a new amp or an old one? At first thought, it makes sense to buy an old one, since the new ones aren't functionally much different, if at all, and they cost quite a bit. Lots of people do buy old amps; I just bought one myself! But, you can get into trouble that way if you're not careful, because tubes are getting expensive and hard to find. And, various amplifiers require different tubes, the price of which can range from $15 to more than $800 each. Ouch! Here are some possibilities you may run into:

Sweep Tubes

Many smaller amps of yesteryear used television sweep tubes. For those too young to remember them, sweep tubes were the ones used to generate the beam-sweeping currents for the yoke coils around the neck of a picture tube. A very common one was the 6LQ6, which also went by the number 6JE6C and a few others. This thing had nine pins on the bottom and an anode cap on top. It was never meant for RF transmitting service, but it could do the job, provided you didn't push it too hard; the plate would glow red and melt down if you tried to dissipate lots of power through the tube. Still, you'll find 6LQ6 tubes in plenty of old amplifiers, like the DenTron GLA-1000 I just bought.

Using any amp requires careful attention to avoiding too much current through the tube, but with sweep lubes you need to be extra careful. You have to tune up quickly, and, when running full-duty-cycle modes like SSTV and RTTY, you have to back off the power quite a bit, lest your tubes become smoldering paperweights. Still, for moderate power output levels of, say, 400-700 watts, sweep tube amps are a decent, cheap alternative to higher-priced units. The upside is that neither the amps nor the tubes cost a great deal. I've seen small amps like mine going for $100-$200 at hamfests. Where else can you get hundreds of watts for that kind of minimal outlay?

The other problem with this kind of amp is that sweep tubes weren't designed for linear service. They will amplify in a linear manner, as will any tube, but even a little overdriving makes them distort a great deal. So, pay extra attention to your radio's output level, and don't push it too hard.

You may also find older amps with 572B and 811A tubes. The 811A was a real transmitting tube, but it's a very old type and not a tremendously powerful one, so you should treat such amps much like sweep tube amps.

The 3-500Z

This Eimac tube is perhaps the most popular one used in more modern amplifiers, and many units in production today use it. These tubes cost about $100–$140 each. That may sound high for a glass bottle, but it really isn't, when you compare its performance to other, more expensive transmitting tubes. The 3-500Z is a good choice. It's a fairly large, powerful tube. You can get full legal output power from one 3-500Z, but that's pushing it, and I wouldn't expect the tube to last a long time under full-load conditions. It's better to get an amp that uses two of them. That way, they'll be loafing along, so they should last for years.

Full Metal-Ceramic Jacket

Metal-ceramic transmitting tubes are used in very high-power commercial installations, and some big ham amplifiers. I once had a DenTron MLA-2500, and it used two 8875 tubes, which were small, metal-ceramic types. Wow, did that thing put out! The tubes were about 20 years old, but it blasted the ether like gangbusters. Although those tubes could dissipate lots of plate current, they were fairly sensitive to grid current, and you could ruin them by overdriving them or transmitting with the amplifier out of tune, because that caused excessive grid current. You sure didn't want to do that, though, because new 8875s cost over $400 each! Used MLA-2500s and similar amps cost about $500–$600 on the hamfest market. If the amp and the tubes are working properly, they're worth it. I wish I still had mine.

Similar metal-ceramic tubes you might run into would be 8877, 8873, 3CX-1000 and 4CX1500A. They all cost a mint, but they're real workhorses that can last the life of the amplifier, and perhaps even the operator, if properly cared for.

Pick One

If you're going to buy a new amp, you can pretty much just pick one from the ads and buy it. There's only a few HF amplifier manufacturers left, so the choice should be easy. Just pick one you like, with the most power you can afford. Chances are, it'll use a 3-500Z or two. Be prepared to spend at least $1000, probably more. If you want to buy a used unit, you have many more choices, because there were lots more amp makers back when ham radio gear was made mostly in this country. Expect to pay from $150 to $600 or so, depending on the age and power of the amp. For a little sweep tube amp, I wouldn't pay over $200, preferably around $125 to $150. For one of the very popular Heathkit SB-220s, around $350 to $500 seems to be the going price. For the big guns, it's $500 and up.

Some designs were prone to parasitic oscillations, which can blow tubes as well as scramble up the spectrum for many miles around, and there were aftermarket kits or factory mods available to fix the problem. When examining a potential purchase, it pays to ask what's been done to it. As with anything, of course, always avoid a unit which appears sloppily modified.

Amateur Beware!

If you buy a used amplifier, be absolutely sure to see it putting out something near its rated power before you plunk your money down. That is, of course, unless the price is so low that you won't mind buying new tubes. I didn't listen to my own advice, and the GLA-1000's seller smiled into my face as he lied and told me that the tubes were brand new and worked great. I got home and discovered the truth: the tubes had no emission at all—they were stone cold dead! Unlike with solid-state devices, tubes can have varying degrees of functionality, including zero. In this case, it wasn't the end of the world; I found a set of good, used tubes at the next 'fest for $15, again taking a chance on the seller's honesty. This time, I got lucky. Had they been 8875s, though, I'd have been in deep doo doo. Be sure to keep the cost of a set of tubes in mind when haggling over a used amplifier!

Wow, this topic is bigger than I expected. Let's continue next time with a look at setting up and using a linear amplifier. Until then, 73 from KB1UM.

Number 16 on your Feedback card

ABOVE & BEYOND

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave.
San Diego CA 92119

1691 GOES Converter, The Local Oscillator/Mixer

Well, last month I described the conversion of an LNA or an LNB to cover useful frequencies for 1691 in particular. This type of design does not have to be frequency specific, but the broadband nature of the converted TVRO converter amplifier lends itself to converters from 1,000 MHz to 3.5 GHz. Whatever your frequency of interest, the principal is the same. A good RF amplifier is a mixer and a local oscillator to convert the high frequency to a lower IF frequency for reception.

I have received several letters wondering where to pick up LNA amplifiers. I got mine for this test project at a local hamfest swap meet. Other locations that might show promise is to look in your local telephone directory for satellite television installers. They usually have some of the older LNA amplifiers of the 50 to 100 degree noise temperature units that have been replaced with lower noise figure units, like 20 to 25 degrees. The newer units are much hotter than the older units and are sought after by TVRO users. The units that they replaced are what we want and usually they can be had for about five dollars.

The conversion of these units is not too difficult. Remove the cover and add a two to five pF chip capacitor to the input of the amp where the previous waveguide connection resided. To the other end of this capacitor connect an input RF connector, usually a SMA or whatever your favorite RF connector is. With an Exacto™ knife, remove the frequency-determining stubs, leaving the bias and main connecting 50-ohm stripline connecting all amplifiers. If you have an LNB, add capacitance to the interstage capacitors by doubling up coupling capacitors to lower the frequency response of the IF amplifier. See Figure 1 for more detail covering these modifications.

The mixer I discussed last month was the Mini Circuits SRA-11, which has good RF performance to 2,000 MHz. The units that I tested I modified by soldering SMA connectors to the mixer pins for quick adaptation to many of the different circuits that I tried. See Figure 2 for SRA-11 connections. Other mixers could be used; I used the SRA-11 because it was available in surplus on a scrap PC board. Any other type of mixer could be used, even a home-brewed one similar to the one that I described in this column several years ago.

The main thrust of this month's column is the local oscillator. It normally would operate on 1554 MHz, using a 137-MHz IF system for weather data reception on 1691 MHz. We obtain 1554 MHz by subtracting the IF from the RF frequency to obtain 1554 MHz.

There are several methods that could be used. One idea would be to use a CATV tuner local oscillator at 1/3 or 1/2 the required frequency. By operating at 1/3 the frequency of 518 MHz, a simple tripler stage and buffer amplifier would be all that is required to be added to the synthesizer-controlled CATV local oscillator. Again, I am using the internal divide-by circuitry in the CATV tuner to input a low-frequency signal to the familiar Motorola MC-145106 synthesizer chip for

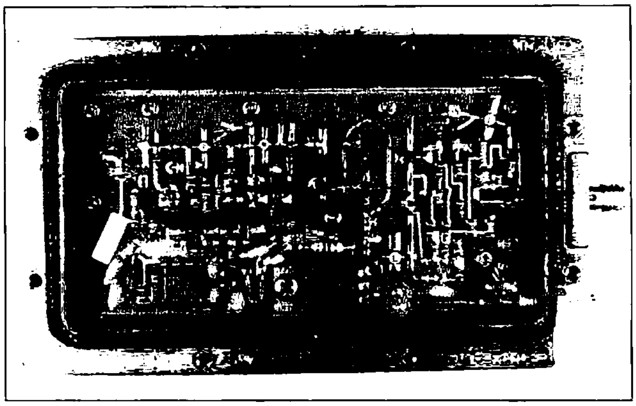


Photo A. Component side view of modified LNB converter. Far left—RF input; right—IF output with feedthrough capacitor for DC power. Mixer just right of center looks like oval racetrack, diode bottom LO input left of racetrack.

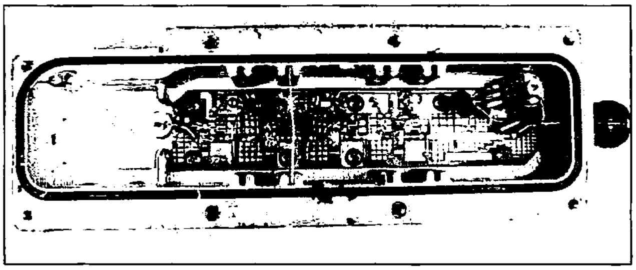


Photo B. Converted 3.7 to 4.2 GHz TVRO LNA converter. Sharp corner above SMA connector is the result of a large waveguide flange removed by bandsawing off the unnecessary metal part of the unit. Left—SMA connector RF input; right—N connector IF output.

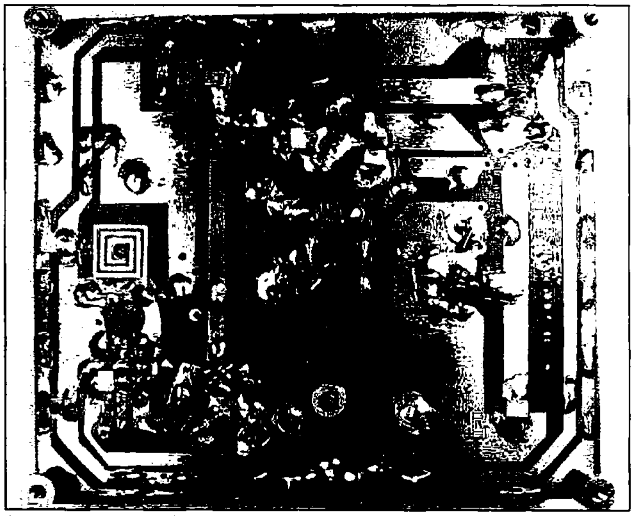


Photo C. Bottom of PC board from RSGB Handbook *for crystal oscillator and harmonic multiplier to 500 MHz range. Note PC board inductor for crystal oscillator.*

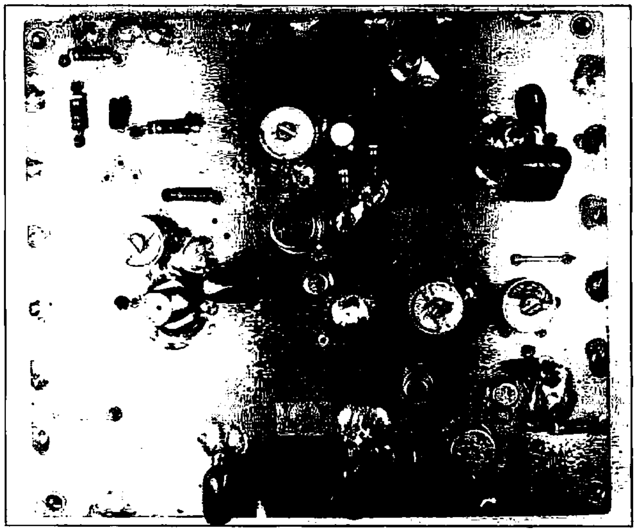


Photo D. Top view of RSGB crystal oscillator.

this type of circuit. See Figure 3 for synthesizer circuitry. Multiplier circuits can be found in many different reference books, such as the *ARRL Handbook's* VHF and UHF sections. Take a look at the designs for the 1296-MHz converter and portions of the circuitry can be adapted from them. Other good sources are the RSGB (Radio Society of Great Britain) VHF, UHF handbook.

Of course, the local oscillator can take the form of a single crystal starting out at a fraction of the required frequency and going through several multipliers until 1554 MHz is obtained. Sort of like a crystal-controlled transmitter multiplier to the operating frequency for CW operation. This local oscillator operation is quite Identical.

The scheme that I would prefer, given a larger budget, is to use a fundamental frequency-controlled local oscillator that is capable of operating on 1554 MHz directly, without multiplication. This type of oscillator is a VCO (Variable Controlled Oscillator). The reason that I did not select a VCO is that most amateurs would have difficulty in obtaining these devices. They are not commonly available. I suspect this project will be attempted by a large number of experimenters and I wanted to name parts easier to obtain. The type and availability of certain dedicated components might hinder those trying to follow a cookbook adaptation of the local oscillator. Remember, I am trying to construct this converter on a shoe-string budget and still make a converter that will perform well.

With preferences aside, what is the simplest system that can be constructed and still do a reasonably good job? A synthesizer-controlled oscillator from a TV tuner with its internal divide-by circuitry coupled to the Motorola MC-145106 synthesizer chip for the local oscillator, I believe. A new idea for the mixer allows the local oscillator to operate on one-half the required frequency, eliminating the multiplier stages previously covered. The best part of the new mixer is that it's home constructed.

The home-built mixer is the key to the simplest converter, as the type of mixer I will describe does not require the local oscillator multiplier previously discussed. This mixer design uses one half of the required local oscillator frequency allowing us to use the TV tuner in it's original operation range, making it a simpler system to construct by eliminating complex components and keeping costs low.

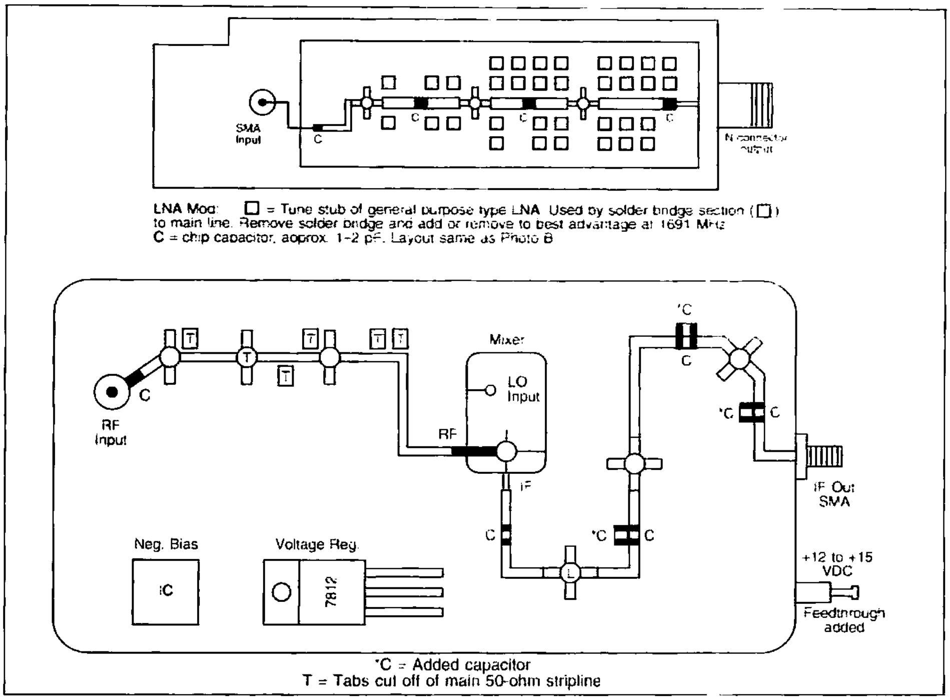


Figure 1. Modifications to LNA and LNB amplifiers.

The Technical Bits and Pieces

Our complete system would comprise a converted TVRO converter amplifier (LNA) for a home-built mixer, a synthesizer controlling a TV tuner local oscillator, and an optional IF amplifier to complete the part of the packaged converter. See Figure 4 for the package block diagram.

Looking at the TV tuner, it in itself is a complete IF converter for a set block of frequencies. CATV type tuners are made to cover

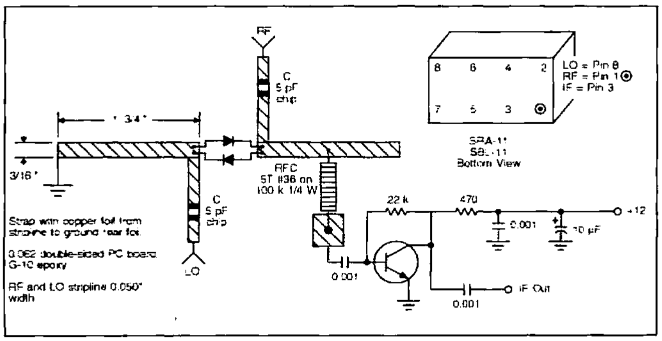


Figure 2. Mixer considerations for SRA-11 and home-built mixer circuits. Note that the home-constructed mixer requires half local oscillator frequency injection (777 MHz) as opposed to 1554 MHz.

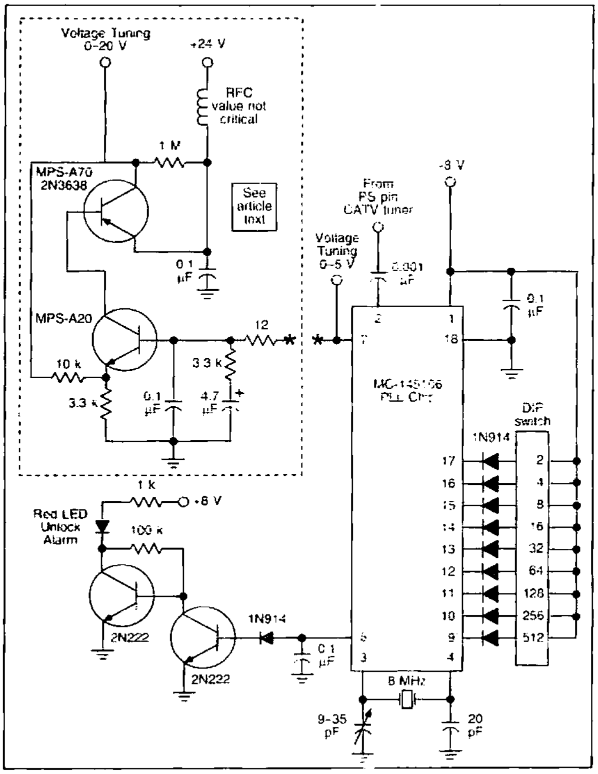


Figure 3. MC-145106 synthesizer schematic details.

ranges of from 50 to over 500 MHz. As such, they lend themselves readily to this type of project. In addition to the amp, mixer, and bandpass filters (which we do not require), the CATV tuners have a local oscillator that is variable by voltage control. It also has a internal divide-by frequency chip that divides the high frequency by a fixed 256 division rate. This divider reduces the LO high frequency to a frequency within the range of the Motorola synthesizer chip.

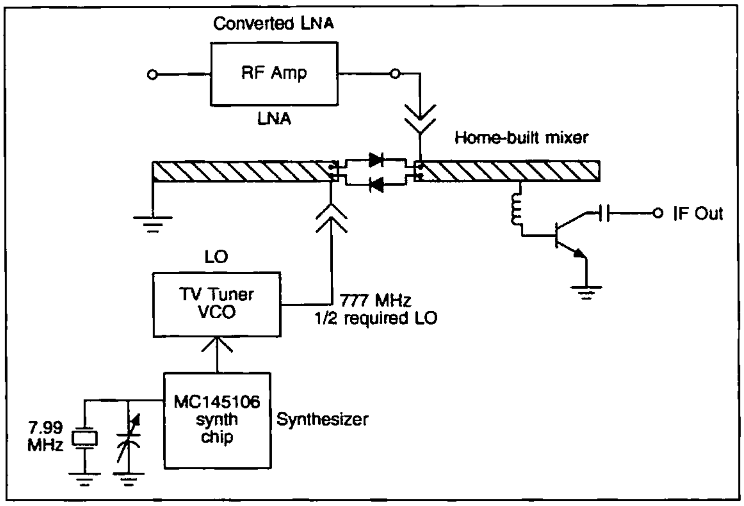


Figure 4. Block Diagram of complete system connections for 1691 MHz converter. Filters for isolation and out of frequency immunity not shown.

The synthesizer chip contains two different counter strings or programmable dividers. One string is for the division of the crystal-controlled reference and the other is to set the required division rate needed to match the output of the LO when it is phased locked to the crystal reference frequency. Both these outputs are connected internally to a phase comparitor which produces an output voltage to control the variable oscillator and set it (with the proper division rate programmed in the synthesizer) to the same frequency as the crystal reference frequency.

In our case, the crystal is 8 MHz exactly and is being divided by 1024, the reference frequency being 7.8125 kHz. Now when the VCO in the CATV tuner is operating on 778 MHz, the fixed divide-by internal to the CATV tuner is 256 making 3.0390625 MHz being output to the Motorola synthesizer chip's divide-by circuitry. By setting the MC-145106 oscillator divide-by rate (can be set from 2 to 511 maximum) to 389, the output of this divide-by chain is exactly 7.8125 kHz, and the synthesizer is locked up and happy.

Of course, when power is applied, nothing is further from the truth. However, when the crystal oscillator starts operating and the 7.8xxx kHz main crystal reference is input to the phase comparitor, the main CATV oscillator is set to some frequency and is being divided down by, first, 256 in the converter, and 389 in the synthesizer chip. At first, the frequency is quite in error and the phase comparitor outputs a correction voltage to bring the variable oscillator in check. It continues to doso either raising or lowering the voltage to make the two frequencies the same. Hopefully, within the voltage pull-in range of the phase comparitor.

i have included in previous articles on the 1296 MHz converter how to lower the tuning voltage sensitivity to allow direct connection to the MC-145106. Also in-

cluded is an interface if you want to increase the voltage tuning range from zero to five volts, to zero to 20 volts by adding the two-transistor circuit. Its a flavor choice item on your part.

Oh, I forgot to tell you—we want to operate on 1554 MHz and while I was working with perfect numbers like 8 MHz and such, I left out this detail. Adjust the crystal lower in frequency by about one kilohertz to permit half LO, or 777 MHz, to be real . Actual reference frequenc quired is 7.802458226 kHz is obtained by dividing 777 by 256 (CATV Tuner) and di ing the quotient by 389 (programmed in the MC 145106 chip). If you set the 8-MHz crystal to 7.98717224 MHz this will all work out. Actually the 8-MHz crystal used as system clock is set 1.3 kHz low in frequency by padding a junk 8-MHz crystal. If you want to be a purist, order a crystal for the exact frequency.

The frequency stability of the system will be just as stable as the 8-MHz crystal is. If you choose to use a higher stability source, it will work as well. It can be connected to pin 3 and ground of the MC-145106 synthesizer chip.

Mixer Construction

As I said, the mixer requires half LO frequency, making this mixer a little unusual but practical, as it affords a simple construction without adjustment. The mixer first surfaced in simple converters for the 2304 MHz amateur band and some TV receiving applications quite a few years ago. It was part of the coffee-can-type of converters popular back then. I have noticed reference to them in *Ham Radio Magazine* in August 1978 and in the 4th edition of *The RSGB VHF/UHF Handbook*. The real source is a mystery to me.

"Oh, I forgot to tell you— we want to operate on 1554 MHz and while I was working with perfect numbers like 8 MHz and such, I left out this detail."

The mixer is constructed on .062 inch double-sided PC board material with the rear of the board serving a grounded-foil ground plane su . The top surface is where th ttern of the mixer is etched or ut out with an Exacto™ knife—dimensions are not critical. The main stripline is 3/16-inch wide and 3 1/2-inch long, broken in the middle for connection to the two diodes. The local oscillator connection is made to the grounded section of the transmission line at the diode connection point. The other stripline is open at its end and the connection is made to the diodes at that point. The IF feed is taken off with a small 5 turn RFC (5 turns #36 enameled wire on a 1/4-watt, 100k resistor form) midpoint along the side of the strip line. The large pad that the other end of the RFC attaches to form a capacitance to ground, shorting out at 1691 MHz, and is a higher impedance at 137 MHz. See Figure 5 for mixer construction details.

Don't forget to have one end of the mixer stripline grounded at one end with as short as possible a piece of copper strap to ground. It forms a shorted transmission line to ground for the local oscillator injection port. The other side of the diodes are connected to the IF output ports of the mixer.

A single-stage IF amplifier finishes out the mixer circuitry. This stage was originally constructed with a type MRF-901 as was the original circuit where I got some of the ideas for this simple converter. Other NPN-type high frequency transistors could be used in this application; it's not fussy. I tried an Avantek AT-85067 NPN-type and it worked as well.

Well that's it for this month. As always, I will be glad to answer amateur-related questions concerning this and other projects. Please send a SASE for prompt response. 73 Chuck WB6IGP.

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister, WA5ZIB
14714 Knights Way Drive
Houston, TX 77083

Digital data and communications via satellite have come a long way since the first OSCAR (Orbiting Satellite Carrying Amateur Radio) was launched in 1961. OSCAR-1 sent "HI" in Morse Code. The speed of the CW was calibrated to the satellite's temperature. It was digital, and it was real telemetry, but times have changed.

Today we have many amateur-radio satellites for both analog and digital communications. To keep up with the analog satellites, an enthusiast uses many modes that are commonly found on the shortwave bands. Voice operation with SSB or FM and standard CW are the most common. Typical VHF and UHF, multimode transceivers are employed without any modifications.

By comparison, digital satellite communications have become quite complex. AMSAT-OSCAR-7 used RTTY over 20 years ago for telemetry transmission. Today AMSAT-OSCAR-13 uses a mix of CW, RTTY, and 400-baud PSK (phase-shift keying) for its telemetry downlink, while other satellites like KITSAT-OSCAR-25 are orbiting digital bulletin board systems operating at 9,600 baud utilizing a form of AX.25 packet. Other satellites like Weber-OSCAR-18 send data and pictures at 1,200-baud PSK, and DOVE-OSCAR-17 sends standard 1,200 baud FM packet data. These are just a few of the digital modes our digital hamsats can employ.

Keeping up with the advances in digital communications via satellite can become expensive. Whenever a new mode is incorporated into a satellite design, the ground-based user needs a new black box to keep up. But there is an alternative. Instead of designing new hardware for each mode, a processing system can be designed to handle many different modes, just by changing software. Today's DSP (digital signal processing) circuits have allowed many prospective digital satellite users an easier path to high-speed operation at 9,600 baud in addition to computerized decoding of RTTY, CW, and even APT weather satellite imagery.

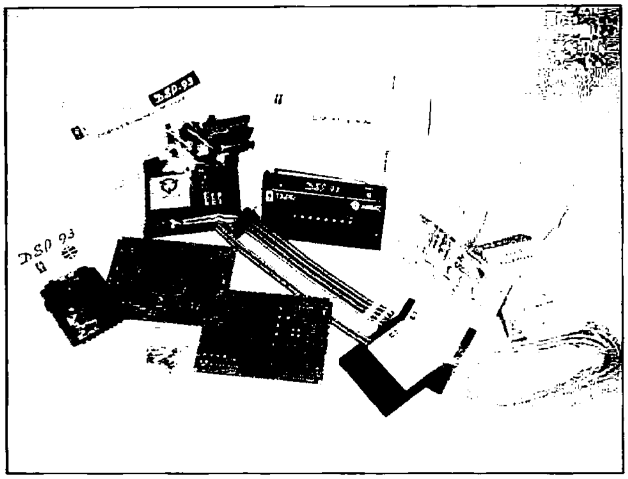


Photo A. The DSP-93 modem kit from TAPR includes all parts, circuit boards, cables, connectors, case, and instructions.

The TAPR DSP-93

The Tucson Amateur Packet Radio Corporation (TAPR) and the Radio Amateur Satellite Corporation (AMSAT) began a joint project in 1988 to create a DSP device for amateur radio use. The complexity of a kit that could be built, calibrated, and used by hams with reasonably advanced kit-building experience was a key issue. After careful study, a system proposed by Bob Stricklin N5BRG was chosen. It was modular, relatively inexpensive ($430), and could be easily interfaced to various input and output devices, such as radios and packet TNCs (terminal node controllers).

"The complexity of a kit that could be built, calibrated, and used by hams with reasonably advanced kit-building experience was a key issue."

Principal design criteria had been identified in April 1993 at the Dayton HamVention. The DSP-93 unit became a standalone unit to support data, audio, and slow-scan video modes when coupled with appropriate software.

The project proceeded from alpha- and beta-test units in 1993 and early 1994, to a first production run in late 1994. A second production run came out in mid-1995. The kit is centered around two four-layer circuit boards with an interconnecting bus structure.

The boards are mounted one above the other with the DSP engine on the lower of the two. This board has a TMS320C25 DSP chip, 32k by 16 bits of program and data memory, the clock circuitry and system I/O using PALs (programmable array logic). The upper board contains the radio and computer interface circuitry.

Radio connections are through two mini-DIN connectors (cable included). Computer access is via a standard DB-9 serial connection at speeds up to 19.2 kbaud, and the TNC connection is via a DB-25 connector. There are two other connections to the

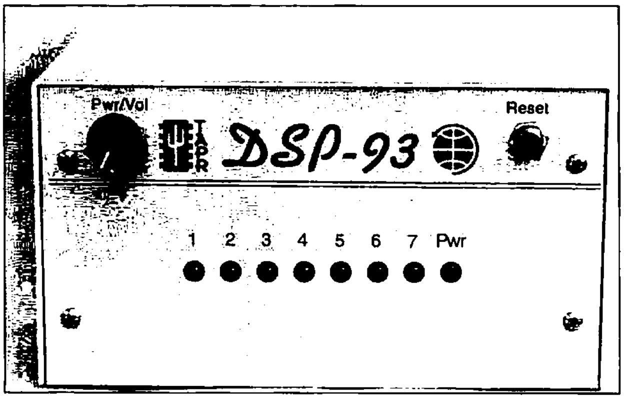


Photo B. The front panel of one of the first DSP-93 modems. Newer units have a black front panel with white lettering.

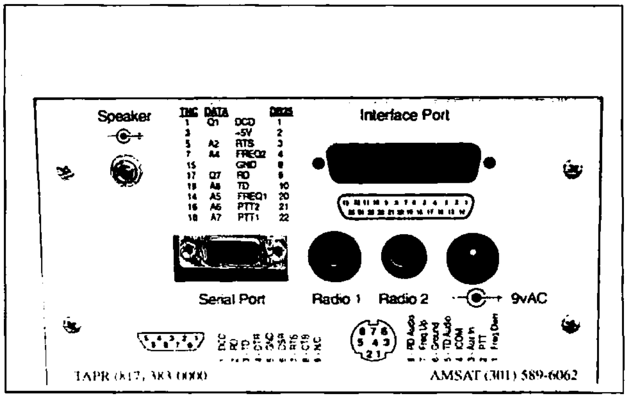


Photo C. The back panel of the DSP-93 is neat and well labeled. The interface port connector on this unit was replaced with a ribbon cable from the modem to the TNC.

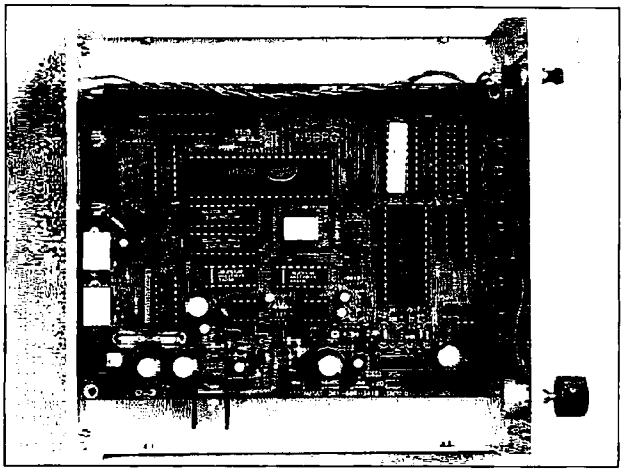


Photo D. Looking inside the DSP-93 at the top circuit board for the radio interface circuitry.

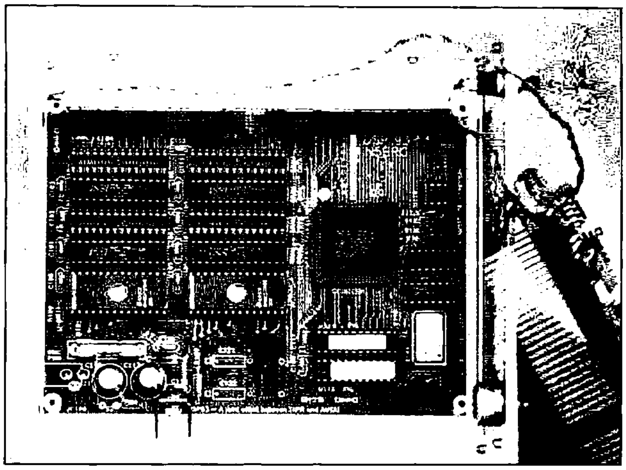


Photo E. Lifting the top board out of the case reveals the DSP Engine with the TMS320C25 DSP IC, memory system, and programmable array logic.

unit for speaker output and power input. The kit comes with a wall transformer that provides nine volts AC at 1.5 amps. External controls include power on/off, volume, a reset switch and an array of eight LEDs that are software configurable to display system status and other functions.

Building the Kit

The DSP-93 is not a simple kit. There are a few hundred parts, and working with four-layer circuit boards can be very messy if the wrong components are installed in a spot and must be removed and replaced. Building time for most has been between 10 and 20 hours with another 4 to 8 to make cables and interface to radios and other gear. Very little wiring external to the circuit boards is required. Most of the connectors for the unit are mounted directly to the upper radio/computer I/O board.

The assembly manual is 33 pages long, is very easy to follow, and spells out the procedures needed to successfully complete the unit. Well-placed notes and warnings are common throughout the text. There's even a little dry humor at appropriate points in the construction. Some information about the connections to the TNC and radios assumes some prior knowledge, but is at least covered via the schematics and documentation files on the supplied disks.

On the Air

Most of those buying and building the DSP-93 get it for 9,600-baud FSK packet work, either terrestrial or via satellite. The simplest way to get going for this mode includes connections to one or two radios using a single radio port jack on the DSP-93. Information is provided on how to connect to various radios for the high-speed modem connection.

The connection to the TNC requires a modem disconnect header interface (typical on TAPR TNCs and clones) back to the DSP-93 using five wires. Four-conductor shielded cable works. A few lines are cut inside the TNC to allow the use of the external modem.

"How many modem boxes does it take to work all the digital modes in the sky? One."

Unlike hardware external modems, the DSP-93 must be told how to operate via software upload. The kit includes two disks with modem programs and text files explaining system use for various functions. To get on the air with 9,600-baud satellites, a program called DSPLOAD is used in conjunction with the program FSKP1.OBJ to set the system for full-duplex, 9,600-baud communications through radio port number one. This is done via the serial port on the DSP-93. The unit is then ready to operate like any other 9,600-baud hardware modem hooked to a TNC.

Software is currently available through TAPR for 9,600-baud work via satellite or terrestrial, and also for TPRS. Some other modes include 1,200-baud AFSK or PSK, 400-baud PSK, RTTY, AMTOR, 300-baud FSK, APT pictures via weather satellite, noise filtering, CW filtering, oscilloscope and spectrum analyzer emulation, and various diagnostic functions. For those with Internet connections, use FTP (file transfer protocol) and attach to ftp.tapr.org to get software and document files. You can also call or write to TAPR. The phone number is (817) 383-0000 from 9 am till noon and from 3 pm to 5 pm Central Time. The address is 8987-309 E. Tanque Verde Rd. #337, Tucson, AZ 85749-9399.

The DSP-93 Future

New software is in development all the time. The DSP-93 is an open architecture, and it is hoped that as more amateurs get their units, more software will be developed and distributed. Some ideas under study include SSTV, speech synthesis, and new data modulation formats.

The modular design of the unit allows either of the main boards to be replaced with future boards designed for unique applications. A faster radio/computer interface could be installed, or as new DSP chips become available, the DSP engine board could be swapped out. There is room in the current box for a TNC interface board, thus making the modem a complete unit with internal TNC.

The DSP-93 system is not the only DSP unit on the market, but it is less expensive, and, for the experienced kit builder, a lot of fun to put together and a very useful tool when complete. How many modem boxes does it take to work all the digital modes in the sky? One.

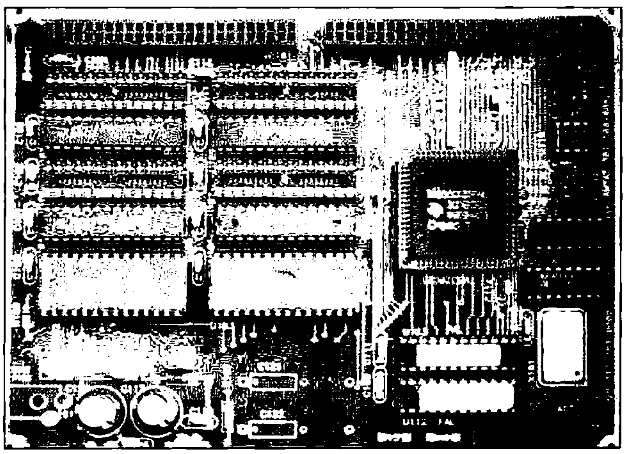


Photo F. A close-up of the DSP engine circuit board, the heart of the DSP-93.

HAMS WITH CLASS

Number 18 on your Feedback card

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

New Resources

The transition from the relaxing days of summer vacation to the structured setting of the classroom is a rough one for teachers as well as students. Be that as it may, it's time to get back into gear with renewed energy—mentally and physically. The start of a new school year is a good time to look over your resource center and classroom library. Discard materials that are outdated or irrelevant, for it's the appropriate time to add new resources to your collection.

As we've discussed in this column before, it's extremely important for instructors and teachers to be interested, stimulated, and involved in order to have the class of adults or children think that they are interesting and stimulating teachers. Keeping yourself up to date with new equipment and the plethora of electronic data that has become available can sometimes become overwhelming. Do what you can. But do something! If you can add a dozen new resources to your repertoire, you're doing fine.

The following are materials and resources that have recently come to my attention and are worth passing along to you as suggestions. As you experiment with new reference materials in your ham radio classes, be sure to drop me a line if you think they are worthy of sharing with others.

1. You can simplify your search for specific children's books with the 1995 edition of *Children's Books of the Year*. Published by the Child Study Children's Book Committee, this annotated list includes more than 600 titles selected from more than 4,000 new books for children, from infants to age 14. Titles are arranged according to age and interest. A special new feature is an insert that lists 20 books, old and new, challenging gender stereotyping. The list may be ordered by sending a check for $6 to Children's Book Committee, Bank Street College, 610 W. 112th St., Dept. LM, New York, NY 10025.

2. A book that can be adapted for children or adults is *What's Inside? Spacecraft* by Dorling Kindersley, Inc. I use this book with my radio classes to introduce the unit on "Space Travel and Communications." It describes how a rocket gets into space, what it's like to travel in a lunar module, and how astronauts manage to spend months on a space station. The Russian space station, *Mir*, is even described with diagrams.

3. NASA Teacher Resource Centers in 11 locations around the country offer educational videotapes, slides, audiotapes, publications, teaching guides, and more. Call the NASA Goddard Space Flight Center Teacher Resource Laboratory at (301)286-8570 to ask for the location and phone number of the center nearest you.

4. Tony Lacy G4AUD has written a computer program that performs Morse Code drills and prepares sample VE type exams. It's called "NuMorse." It is written to run under the Microsoft Windows operating environment (most other Morse Code programs operate only in DOS). It is distributed as shareware via the CompuServe online service. The program runs under Windows 3.1. It provides a source of accurately generated code that can be as slow as required in the early stages, and then gradually increased. For more information write to: A. Lacy, 58 Bilbrook Road, Codsall, Wolverhampton WV8 1ER, United Kingdom, or call Donald Bell KI5YT at (817) 761-9207, fax (817) 761-9277.

"Keeping yourself up to date with new equipment and the plethora of electronic data that has become available can sometimes become overwhelming."

5. Joseph Carr K4IPV, a fellow columnist in *73 Amateur Radio Today*, is always coming up with creative materials to use in the classroom. His "Crash Course in Statistics," a multimedia course on CD-ROM, is too advanced for my kids in 6th–8th grade, but gifted math students and those in the upper grades will probably enjoy and learn from the program. Each subject is broken into easily understood units. You learn at your own pace, repeating sections and topics as often as you wish. Voice narration, animated graphics, interactive examples, sound effects, and video clips make the subject come alive in a way not possible with books. System requirements are: 386 PC (or higher), Windows 3.1, 4 MB RAM (8 MB suggested), 256 color monitor, 8-bit sound card, CD-ROM Drive, and a Mouse. A 144-page study guide and desk reference supplement the CD-ROM. Carol Lewis of HighText Publications wrote the CD-ROM software, and Joe wrote the book. Joe Carr can be reached at (703) 941-1230.

I wish all of you teachers and instructors the very best of successes with your classes this year. Don't be shy; share your suggestions and success and/or failure stories with the rest of us. Exchanging experiences and techniques will add to your own stimulation, which will then translate into better, more exciting lessons and presentations. Good luck!

Photo A. You should continue to update all resource materials in the classroom.

Photo B. Globes, maps, and atlases are some of the resources needed in ham radio classrooms.

RTTY LOOP

Number 19 on your Feedback card

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

Thanks!

November is the month of Thanksgiving, and, every year at this time, I am reminded about the many things to be thankful for in this world of ours. While it may not be one of the biggest things, the readership of this column continues to deserve my personal thanks. To wit, let's take a look at what some of you have recently sent my way.

James Thomas drops a note from Taiwan, where he is the Sysop of the World Data Exchange Information Service, having read about the XPCOM program. He says that he just got his hands on an IC-7100, IC-R72, and CT-17 interface controller from ICOM, and can't find a program in Taiwan or on the Internet that will allow the ICOM CT-17 to control his two ICOM radios via the computer. He is looking for any leads on where on the Internet such a program could be found.

Well, James, I searched the literature, I have, as well as the Internet, using various search engines, and came up blank also. Readers who think they could help, can E-mail James at root@twwde.com.tw being sure to send me a copy of the information, as well. Let's see what the RTTY Loopers out there can do!

A note from Michael Cotty N9RIK strikes a familiar chord. He asks for information as to how to shield a PC in order to cut down on interference to a two meter radio. He is trying to run the BayCom software, and appears to be having some problems.

Michael, if you have an older computer, one with a plastic case, you may be in real trouble. Shielding those babies can give new meaning to the term "exercise in frustration." On the other hand, most newer computers are built inside of shielded cases to comply with FCC regulations for home electronics (Class B devices). Therefore, most spurious emissions are not coming from the computer, but from cables which enter and exit the computer. Solution? Shield, shield, shield. Use some old shield braid from coax around interconnecting cables. If that does not entirely remove the interference, try a ferrite bead or toroid. Suspect cables. There may already be one on your keyboard and monitor lead: take a look. Good Luck, and keep us posted on your progress.

Bob KF8PH tells of his purchase of a sound card with the AMD DSP chip at Dayton this past spring. He also acquired a Radware "radio on a PC card" which he uses for receive from time to time. He is looking for an OS/2 driver for the card, but has found the search fruitless to date. Anyone out there that can help, we would be interested in hearing about it.

While we're off the MS-DOS track, I received a message from Rejean Bisson, VE2BSE, who says:

"I could use your help in getting JNOS or KA9Q for SCO UNIX ODT 3.2.4. I operate this at my house, and I love it, but I have just a version of KA9Q, which does not support TCP/IP on my local network. I have TCP/IP and NFS on my system, and I would like to be able to do Telnet and FTP locally.

"Presently, I use JNOS 1.10i in DOS, and with this version all is okay, but I would like to try running the UNIX version on my machine, and closing down the DOS server."

While I have no ready source, I am delighted to open it up to the readership. Contact @internet: Rejean at rejean_bisson@inno.org or ve2bse@n0ary if you can help.

Back to the BayCom systems, Kelly Copley dropped me an inquiry looking for companies which produce the BayCom interface. One *73* advertiser who has been featuring such a device is Tigertronics, Inc. For about $50, their BayPac modem is a tad bigger than a DB-25 connector, and features everything needed to run BayCom on your computer, with no external power required! Contact them at 1-800-8BAYPAC, or (503) 474-6700 for those who cannot access US toll-free lines. See their ad in this month's *73 Magazine*.

Can it all be high-tech? Nah, here's a note from John P. Cummin, Sr., AD4S who says:

"I have a complete model 28 that used to belong to the local weatherman, Johnny Beckman W4BTX. But no documentation. Sure would like to get my hands on a model 28 manual. I do have a complete model 19 manual from years ago. My brother, W5CE, and I are working toward some kind of a ham radio, computer museum, and want to get as much of the old stuff working as possible. I have an ST-6 demodulator that I plan to use. Any help would be greatly appreciated . . . glad to pay postage, etc. p.s. I have been subscribing to *73* since January 1961 and, until I had a water pipe break in my basement, had every issue. Certainly have enjoyed your column through all those years. Thanks for all the effort."

Contact him at SGRG82A@prodigy.com if you can help out. I'm sure that someone out there has a manual mildewing in the basement.

As to your p.s., for less than $300, the complete series of *73*, as well as other ham radio magazines, is available on microfiche from Buckmaster. I have no idea if they plan to issue the collection on CD-ROM instead of fiche, but that sure would be nice. You might contact them, look on the World Wide Web at http://www.buck.com/ as mentioned last month.

As I write this column, the east coast of the United States has had a month of drought, and the hurricanes in the Atlantic passed the halfway point in the alphabet. This month's Web site features all you need to look at what's going on with weather, and weather related information. Check out http://user.itl.net/~equinox/index2.html for Solar Information and World Weather Index, invaluable to the radio amateur.

In the beginning of this column, I suggested that there are some things which may be, shudder, more meaningful than ham radio. Let me suggest something to you, if you haven't thought of it already. Every day, thousands of people's lives are in jeopardy, waiting for an organ donation. I'm not talking about high-profile actors or athletes, but ordinary mothers, fathers, and children; all races and religions; unified in their need. Be an organ donor. Think of organ donation if you are faced with a tragic loss in your family. Believe me, you never know when it can happen in your own home.

ATV

Number 20 on your Feedback card

Ham Television

Bill Brown WB8ELK
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Atlanta Balloonatics

On August 5th, a group called the Atlanta Balloonatics launched a high-altitude weather balloon from Crossroads Elementary School in Dallas, Georgia. Attached to the balloon were two separate payloads containing ham radio experiments.

The ATV-Beacon Package

David Rice KD4SHH built the ATV and 2m beacon section of the first payload. The ATV section consisted of a P.C. Electronics KPA5-RC transmitter on 434 MHz feeding a quarter-wave coaxial whip antenna and a miniature b/w camera pointed out the side of the payload. The 2m transmitter was an Agrelo Engineering half-watt FM unit sending out a modulated CW telemetry sequence.

Will Payne N4YWK built the telemetry and 10 meter beacon section out of a Basic Stamp module and a 12-bit A/D converter (for the pressure sensor altimeter). The CW telemetry sent back values representing both inside and outside temperature as well as altitude. The telemetry was carried on the 2m FM transmitter on 146.575 MHz, the 10m CW transmitter (a keyed clock oscillator module on 28.322 MHz) as well as the ATV audio subcarrier. Two fiberglass fishing rods (complete with flags attached to the ends) were mounted horizontally to the styrofoam package to support the 10 meter dipole and to help keep the payload from spinning wildly during the flight.

In addition to the telemetry the Basic Stamp controlled a small R/C servo that periodically lowered a small mirror in front of the TV camera to provide a view of the ground below. The power source consisted of a lithium-cell pack.

The APRS/GPS Package

Ralph Fowler N4NEQ put together a separate payload containing an APRS/GPS automatic positioning system. This compact system consisted of a Motorola Basic Oncore GPS board, a PacComm Pico Packet and a TEKK radio on 441.0 MHz running 2 watts of output power. This system was designed to take the guesswork out of DFing a balloon in flight since this payload would constantly update its latitude, longitude, and altitude. Since the Pico Packet formats the GPS string into an APRS compatible format, anyone on the ground running APRS could follow the balloon position as it tracked across the APRS map. It was planned to relay the balloon's position to the APRS network on 145.79 and 10.151 MHz, so that those outside the local coverage area could follow the flight as well.

The Chase

Although delayed by poor weather at the launchsite earlier in the morning, a break in the clouds allowed a launch just after 11 am. Unfortunately, as the balloon was released, the swivel attachment to the last payload broke leaving the APRS/GPS payload on the ground as the ATV system headed skyward. It was one of the fastest recoveries of a balloon payload (and one of the shortest flights!). Had the packet payload made it off the ground, it would've set yet another record. It turns out that while inflating the balloon, the payload had been sitting on an anthill. As we inspected the grounded payload, we discovered that dozens of "Antronauts" had almost hitched a ride to the edge of space!

The ATV signal was somewhat weak during the flight, but even so was received as far away as Huntsville, Alabama, by Gene Marcus W3PM. The 2m signal was heard in Huntsville by KE4EER as well as throughout the southeast and even attracted the attention of a group near Anderson, South Carolina. They were concerned that someone in Atlanta must've been running incredible power (way over the legal limit) to be heard so far away without a band opening. They were amazed when they discovered that the bone-crushing signal was actually only around 1/2 watt (antenna height really makes a difference!) and they're looking forward to listening to more balloon flights.

Around eight tracking vehicles set out to follow the balloon's progress as it headed up to 100,000 feet in altitude. Without

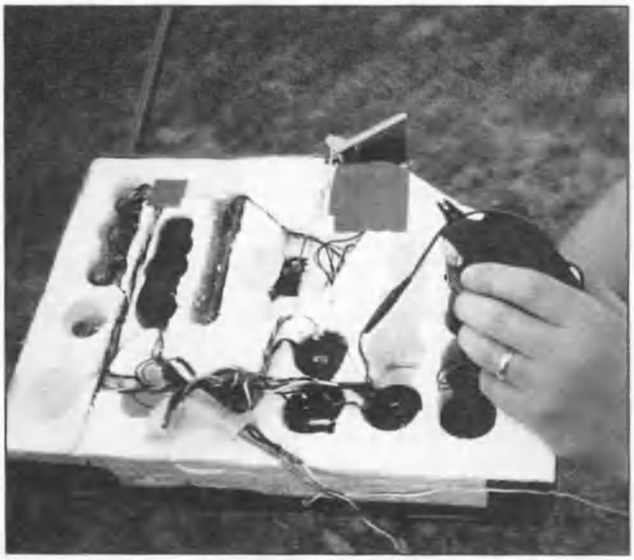


Photo A. The ATV and telemetry payload included a live camera and a servo-controlled mirror to view both the ground and the horizon.

Photo B. As David KE4VHA looks on, Ralph N4NEQ makes final adjustments to the GPS/APRS payload prior to its attempted liftoff.

Photo C. Left to right: Robert Kicker N5QBF and Ralph Fowler N4NEQ retrieve the ATV payload from the uppermost branches of the fallen tree

Photo D. The Atlanta Balloonatics are thrilled to have finally recovered their payload after an exciting chase and retrieval.

the GPS payload, we had to track it the old-fashioned way with directional antennas and Doppler systems. Many of the chase team had APRS/GPS systems in their vehicle, which made the job of triangulating bearings for mission control a breeze. In the mobile command center (KE4VHA's motor home), Phil N4NBL and Tom KE4WIO used the APRS program to automatically track the positions and plot the bearings of the APRS-equipped chase vehicles. Bearings from vehicles without packet could be manually entered at mission control and plotted as well.

Many of the tracking vehicles were using a unique and very sensitive Doppler tracking system (called Directional Systems) developed by Jim Sorenson KA4IIA. For more information about this system send Jim email to: KA4IIA@radio.org.

I headed out with my friend Melody Johnson and stopped on a hill near the predicted landing point. Unfortunately, the only DF equipment we had with us was a 2-element quad to receive the ATV picture. As the payload descended on parachute after the balloon burst, we were able to track the location fairly well just by twisting the quad back and forth while sticking it out of the sunroof of Melody's car. At one point, it appeared to pass directly over the car. By taking note of the updated location from the tracking net and a seat-of-the-pants guess, we zipped off to the northeast. After the payload landed, no one could hear any signals. After a few minutes we topped a small rise, and were thrilled to hear the 2m beacon weakly break the squelch. Mostly by following Melody's intuition, we got close enough to finally see the ATV picture. As we drove into the driveway of the Evers farm, we had a snow-free picture showing lots of tree tops as the payload swung around in the wind. Within a few minutes, Mr. Evers' formerly peaceful farm was inundated with foxhunters carrying strange antennas as the chase teams converged on the payload's signals. The Evers carried us across their cow pasture with 4-wheel motorcycles and a golf cart where we discovered the payload hanging about 100 feet up in a Sweet Gum tree; way too high to climb safely.

Mr. Evers' son tried to shoot the payload down with a dozen rounds from his rifle, but only managed to shoot a few limbs off near the payload. Finally, Will N4YWK climbed 20 feet up with a cable and tied it to the tree. His descent from the tree was less than graceful, but he did manage not to break anything!

"After a few minutes we topped a small rise, and were thrilled to hear the 2m beacon weakly break the squelch."

After all else failed, the rifle was put away and the chainsaw was brought out. As Mike Ray WA4YUR's truck winch pulled, the tree smashed down with a great snapping crash narrowly missing the front of the truck. The chase crew ran up to the former top of the tree and gently plucked the payload out of the limbs. Amazingly, after all of the abuse, the payload was still transmitting a perfect picture and the mirror mechanism still worked flawlessly!

We ended up sawing up the tree and stacking the wood neatly for the Evers family. Everyone left happy, we had the payload and the Evers had a lot of new firewood. We even ended up with 19 pounds of freshly picked okra that was handed to us as we departed. You meet the nicest folks when you drop balloon payloads on their property!

The Atlanta ATV WWW Page

For those of you who enjoy surfing the World Wide Web on the Internet, you can find out about upcoming flights sponsored by the Atlanta Balloonatics as well as pages of information about APRS (maps of the Atlanta area are available for downloading), the Big Shanty Repeater Group, and the Atlanta Amateur Television Network. Start out at the home page address of http://www.mindspring.com/~rwf to begin your visit.

There are charts to decode the balloon's CW telemetry information, construction projects complete with schematics and diagrams for ATV and links to other ATV groups' home pages. Currently, you can link directly to the ATN (Amateur Television Network—Southern California), the East Tennessee ATV group, and the Houston Amateur Television Society.

Number 21 on your Feedback card

CARR'S CORNER

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Op-Amp Bandpass, Peaking, and Notch Filters

Traditional filter circuits are made of inductor (L) and capacitor (C) elements arrayed in passive, frequency selective circuits. All such circuits have an insertion loss (gain of -dB) associated with them, and under the right circumstances they don't filter properly. Indeed, there are load and input impedance combinations that make a filter actually peak, rather than attenuate, certain frequencies in the stop band. Active filters, on the other hand, are made using an active element (such as an operational amplifier), so have gain rather than loss. They are also a bit more predictable as to performance because they do not depend so heavily on having the proper input and output impedances. In this article, we will take a look at examples of active bandpass, peaking, and notch filters.

Filter Characteristics

Three different forms of active filter are discussed in this article, so it's appropriate to take a look at the frequency response characteristics of all three. The response for a bandpass filter with a moderate bandwidth is shown in Figure 1A. The bandwidth of the filter varies across its entire passband, so for the purposes of standardization the bandwidth is measured at the point where the response drops off -3 dB from the peak response at the center frequency (F_c), or in the terms of Figure 1A the frequency difference F_H-F_L.

A "figure of merit" for the filter is termed "Q," which is the ratio of center frequency to -3 dB bandwidth. For example, if the center frequency is 1,000 Hz, and the bandwidth is 250 Hz, then the Q is 1,000/250, or 4. The general rule is that the higher the Q, the narrower the bandwidth.

A wider bandwidth—that is, lower Q—bandpass filter frequency response is shown in Figure 1B. In this case, the -3 dB points are wider apart than in Figure 1A. A filter such as this might be used in a transmitter modulator to limit the audio bandwidth, or in a receiver audio preamplifier to limit the bandwidth to that of the transmitted audio.

A special case of bandpass filter is shown in Figure 1C. This circuit is called a peaking response because it is very narrow, and will accentuate frequencies in the immediate vicinity of F_c, and attenuate all others. An example of an application for this type of circuit is in low-cost CW receivers. The peaking circuit center frequency (F_c) can be positioned over the desired tone, causing it to be accentuated in the receiver output and to attenuate interfering signals away from the center frequency.

The inverse of the peaking response is the band reject, or notch filter, response shown in Figure 1D. This response is used when one wants to eliminate a given frequency. It is often used in the same CW receivers as the peaking circuit, but is used to notch out nearby interfering signals. A low-cost home-brew receiver can benefit quite a bit from an audio section that combines the peaking and notching filters.

Another application for the notch filter is to eliminate 60-Hz interference from scientific and medical instruments. Radiation from power lines will get into the input circuits of sensitive instruments, causing problems. For example, your doctor's electrocardiograph (ECG) machine uses electrodes attached to wires from a multi-wire cable to measure voltage drops caused by the beating of your heart. These leads are typically unshielded at the very ends, and thus are susceptible to picking up 60-Hz signals from the power lines. As a result, many ECG machines either use a filter all the time or have a filter that can be switched in to eliminate the interference (the switched version is usually preferred in diagnostic machines because all filters distort the processed waveform at least a small amount).

Multiple Feedback Path Bandpass Filter

The multiple feedback path (MFP) bandpass filter is shown in Figure 2. The equations for the component values are also shown in Figure 2, and are valid for $10 \le Q \le 20$ and gains ≤ 15. The values of the components given are for a 2.2-kHz center frequency, a gain of 5 and a Q of 15 (about 150 Hz). Other combina-

Table 1

F_c (Hz)	C1(µF)	C2(µF)	R1	R2	R3
100	0.1	0.1	47.7k	536	477k
250	0.1	0.1	19k	215	191k
500	0.1	0.1	9.5k	107	95.5k
1,000	0.01	0.01	47.7k	536	477k
5,000	0.001	0.001	95.4k	1,072	954k
10,000	0.001	0.001	47.5k	534	475k

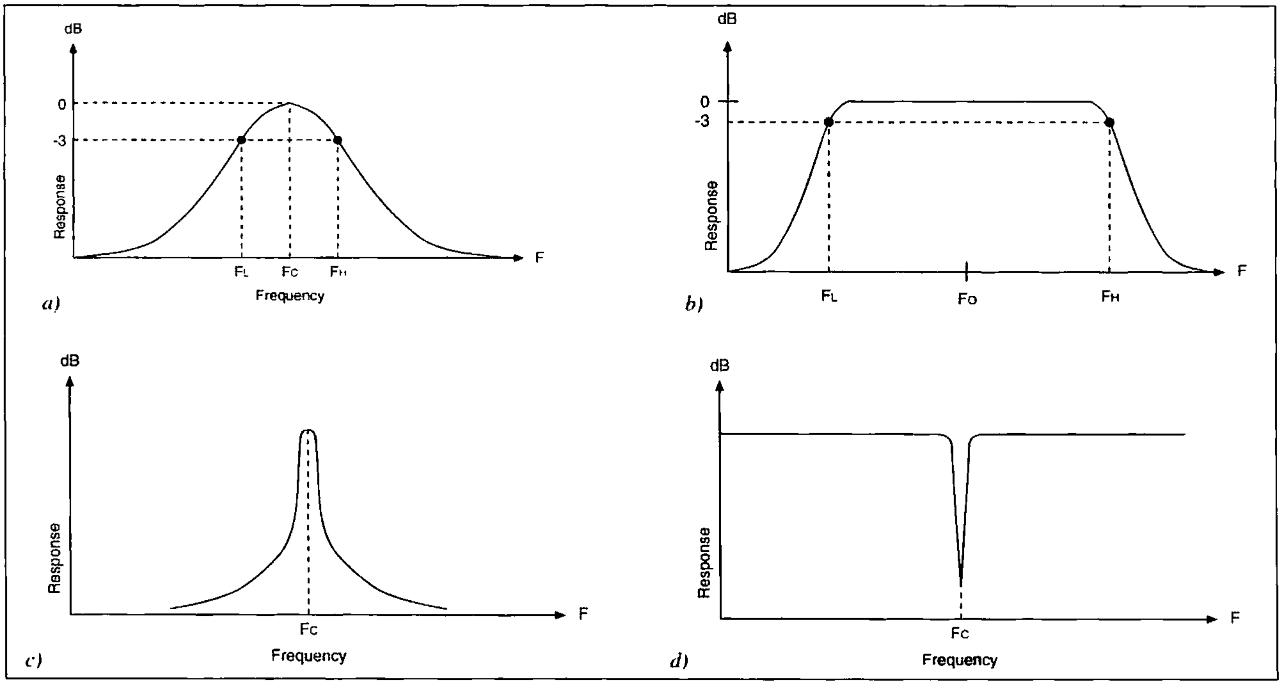


Figure 1. Frequency responses for: A) Moderate Q bandpass filter; B) Low-Q bandpass filter; C) peaking filter; D) notch filter.

tions can be calculated from the equations, or taken from Table 1.

Alternatively, there you can use a filter calculator program such as FilterMaker to find the values for other center frequency, gain and Q combinations (see end of column).

Peaking Filter Circuit

The circuit for a narrowband peaking filter is shown in Figure 3. This circuit is basically a noninverting amplifier with positive feedback. The negative feedback path is set to unity by a direct connection between the output terminal of the operational amplifier and the inverting (-) input. A frequency selective RC network connects the output to the noninverting (+) input, providing some positive feedback. The center frequency is:

$$F_c = 1/2\pi R1\ (C1C2)^{1/2} \qquad (1)$$

Where F_c is the center frequency in hertz (Hz), R1 is in ohms, C1 and C2 are in farads.

Notch Filter

A notch filter rejects a narrow band of frequencies around the design center frequency. Figure 4 shows a type of notch filter based on the peaking circuit of Figure 3 (A2), along with another operational amplifier (A1). The circuit of amplifier A1 has an unusual configuration: The input signal is applied to both the inverting (-) and noninverting (+) inputs. The feedback resistor (R3) is connected in the usual manner from the output of the operational amplifier to the inverting input. The peaking circuit, which in this case sets the notch, is connected between the noninverting input and ground. The notch frequency is set by the same equation (equation 1 above) as for the peaking circuit.

I've used this circuit at both 60 Hz and at about 800 Hz (for a low-cost CW receiver), and found it worked fine. The capacitor (C1) can be used to tune the notch frequency. In some cases, you may want to use a trimmer capacitor for C1, in which case the frequency will be tuned once and then left. This is the case for a 60-Hz filter. In other cases, C1 will be a shaft-operated variable capacitor that can be tuned from the front

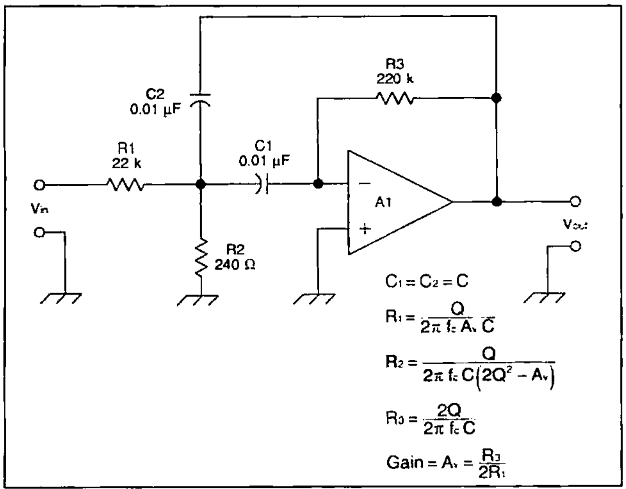


Figure 2. Multiple feedback path (MFP) bandpass filter.

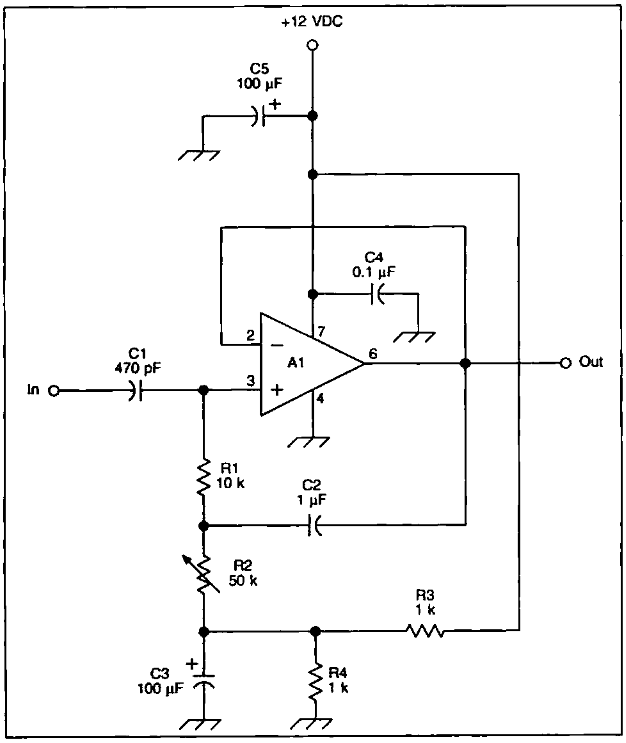


Figure 3. Peaking filter circuit.

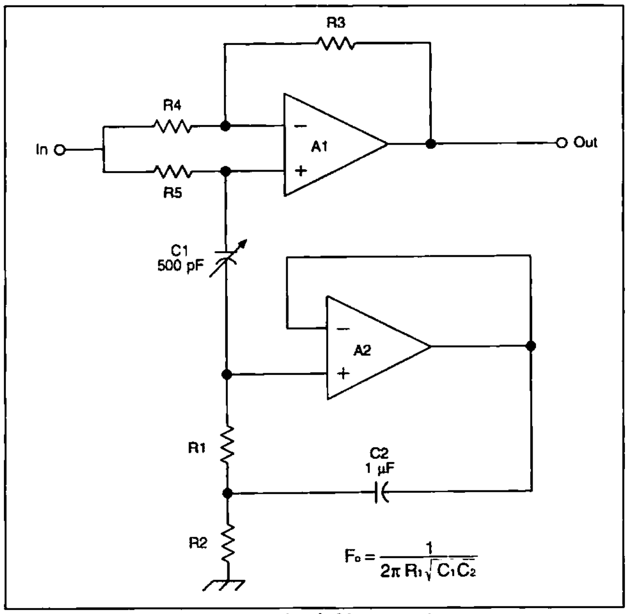


Figure 4. Notch filter circuit.

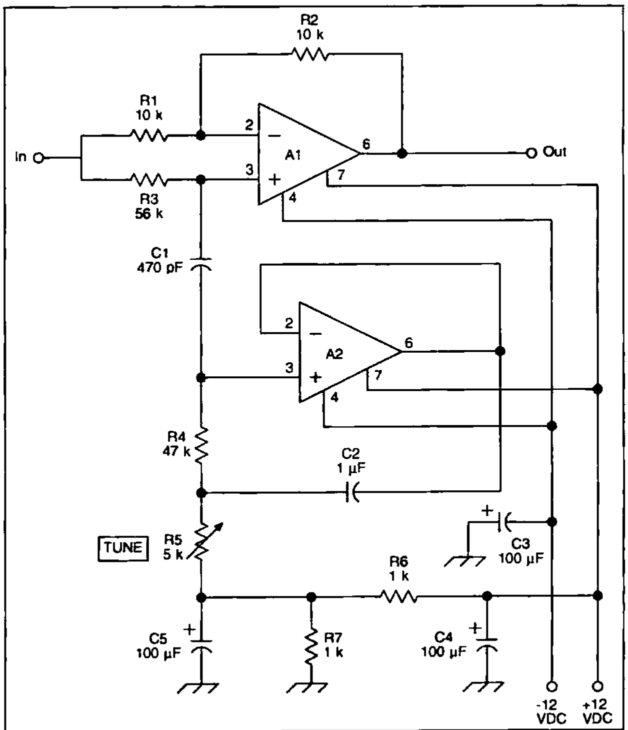


Figure 5. 600 to 3,000 Hz resistor tunable notch filter.

Table 2

Frequency Range (kHz)	Inductance Range	C1 Value
34–68 kHz	2.7–10.9 mH	250 pF
68–137 kHz	0.68–2.7 mH	62 pF

panel of the project (as in a receiver).

Figure 5 shows a version of the notch filter that will tune roughly from 600 Hz to 3 kHz, and has been used by ham and SWL builders for a number of years. it is used for notching out unwanted CW stations, or for notching out heterodynes in receiver outputs. Insert this filter between the headphone output of the receiver and a power amplifier stage.

Gyrator Bandpass Filters

The gyrator circuit (Figure 6) has been around for a number of years. This active circuit can be used in place of an inductor. With two operational amplifiers (two sections of a dual or quad op-amp are preferred), the value of the inductance simulated by this circuit is:

$$L = R1\ R3\ R5/(R2/C4) \quad (2)$$

or, in the case where R2 = R3,

$$L = R1\ R5\ C4 \quad (3)$$

In a previous article, I discussed the very low frequency (VLF) receiver used by members of the American Association of

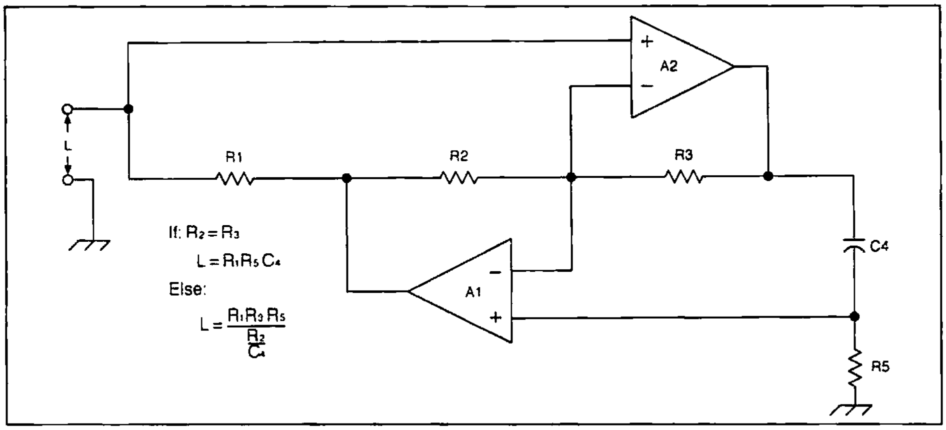


Figure 6. Basic gyrator simulated inductor circuit.

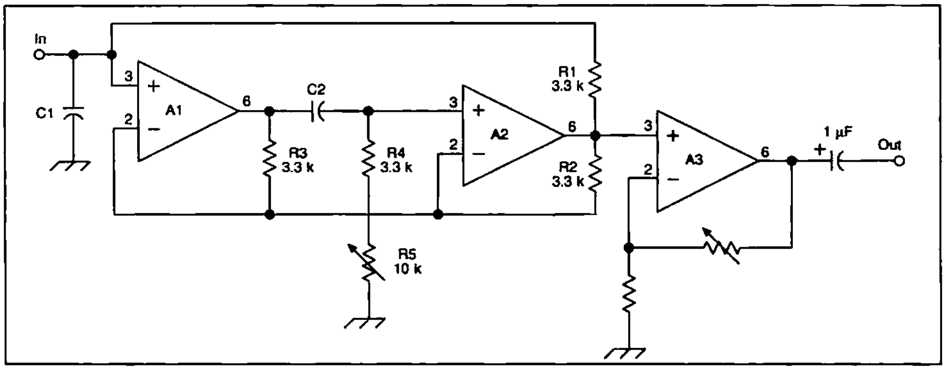


Figure 7. Ultrasonic/VLF tuned amplifier using a gyrator-simulated inductance.

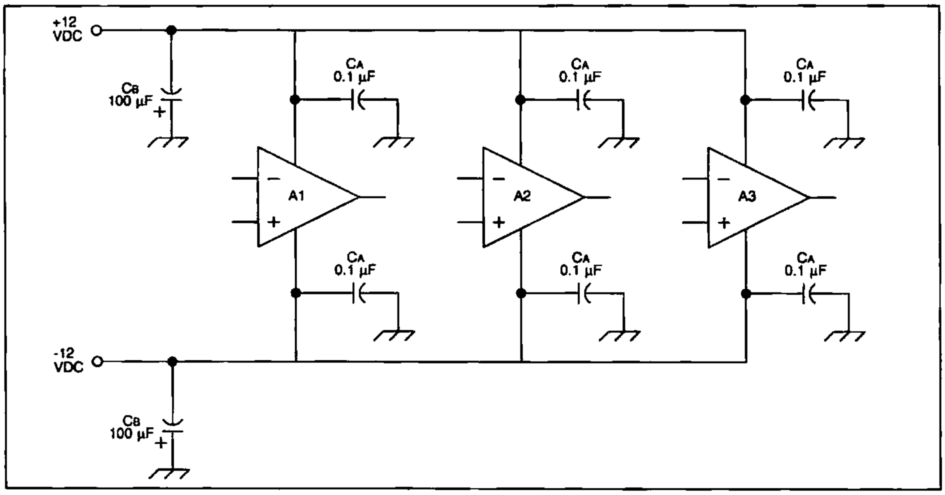


Figure 8. Proper DC power supply filtering for multistage or multi-op-amp circuits.

Variable Star Observers—Solar Division (AAVSO-SD) to monitor frequencies in the 17- to 30-kHz region (designed by Art Stokes N8BN). Since then, I was contacted by the head of the organization and informed that a gyrator version was now the preferred circuit. The main problem with all previous VLF receivers was that the inductors have very large values (≈50–120 mH), and are thus hard to find in variable forms. The gyrator receiver (also a Stokes design) solves that problem.

The RF portion of the VLF receiver is shown in Figure 7 (a precise rectifier/filter circuit is needed following the output of Figure 7 to generate the DC signal monitored by SID-hunters). To tune the SID-hunting frequencies, C2 is 0.001 µF. The range of inductance simulated is 10.9 to 43.9 mH. If C1 is a 0.002 µF unit, then the tuning range is 17 to 34 kHz. Other ranges can be obtained with the same value of C1 (0.002 µF) by using the component values of Table 2.

The DC power distribution of multistage, or multi-op-amp, filter circuits needs to be well conditioned in order to prevent oscillation either in one op-amp or, because of poor power supply, decoupling between op-amps. Figure 8 shows the proper way to keep these problems under control. The capacitors marked C_A are 0.1 µF to 1 µF, and must be mounted as close to the body of the protected operational amplifier as possible. A larger capacitor (marked CB in Figure 8), 100 µF to 500 µF, is connected between each power supply line and ground, usually at the point of connection to the power supply. Note that these capacitors are polarity sensitive, and so must be connected into the circuit properly or they may be damaged (large value electrolytic capacitors can blow up if connected into a circuit backwardsl).

FilterMaker Software

The values for bandpass, peaking, and notch active filters shown in this article, as well as the values for passive low-pass and high-pass filters, can be calculated from a Windows program called FilterMaker. This software is available from the author for $20.00 at P.O. Box 1099, Falls Church, VA 22041. System requirements include a 1.44-megabyte floppy drive, and Windows 3.1 or higher.

QRP

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Add 'Em On

With all this talk about RIT circuits, and other add ons for the Small Wonder Labs rigs, I guess it is about time that I mention how you can get your own copy.

Currently, the Small Wonder Lab transceivers are made for 160, 80, 40 and 30 meters. Sorry, a 20 meter version is NOT available. To get your own Small Wonder, just send a check or money order to:

Small Wonder Labs
Dave Benson
80 E. Robbins Ave
Newington, CT 06111

The Small Wonder Lab rigs are \$50. The matching case Is \$32. The RIT Is \$7. The prices include shipping on all items.

The Small Wonder Labs transceiver does not have an RIT. But, you can either home-brew something up or get one that will work right off of the get go. In fact, order one from Dave when you place your order.

The schematic shown is the RIT from Dave. It's really simple to build. Dave gave me permission to reprint the schematic and PC board for his RIT.

Here's how this RIT works. Remember, the Small Wonder Lab transceiver's frequency is controlled by a varactor diode.

The heart of the RIT is the CD4066 quad analog switch. This 14-pin DIP package contains four small SPST switches. Each switch is insulated from its brothers and all four are "turned on" by applying a voltage to one of the control pins. A "high" applied on any given control pin will cause the switch to be on.

How it works is, if the RIT is on, pin 13 is normally high, closing the switch at pins 1 and 2, thus connecting the RIT pot to the transceiver's varicap biasing network. When the transmitter is keyed, or the RIT is turn off manually, by switch S1, the RIT is removed from the varicap network. Switch section consisting of pins 10, 11, and 12 forms a network along with the 5.1k resistor to ensure the transmitter is not affected during key down. As long as pin 12 and 13 are high, the RIT is functional. Keying the transmitter pulls pin 13 to ground via diode D1. The 100k resistor pulls up both pins to the V_{CC}.

As an afterthought, and I have not tried this yet, you could snitch a slight amount of voltage from pin 12 to drive a transistor switch. This switch would then drive an LED to show if the RIT is active or not. Use typical junk box parts such as a 2N2222 or a 2N4401 transistor. Tap off of the unregulated side of the V_{CC}: the onboard regulator is only rated at 100 mA.

Since this is such a simple project, and there is a PC board available, that is what I would use to assemble the RIT circuit. But, there is nothing wrong with some perfboard and hard-wiring the critter, either.

I added a 0.1-µF capacitor onto pin 14 of the CD4066 chip. This capacitor will keep most of the crud from the IC. I guess a 22-µF capacitor tacked onto pin 14 would not be a bad idea, either.

There is room on the board for a few mounting holes. These are not drilled. I chose not to drill the holes for two reasons. First, I really did not want to mess up the case I had my 30-30 in. Second, I could not find the drill. So in keeping with classic home-brewing in mind, I used a patch of double sided foam tape. Works great! The RIT went under the main PC board with the leads running out from the right-hand side. This kept the lead lengths as short as possible on their way to the tuning pot.

The RIT works surprisingly well considering the simple nature of the circuit. If you have one of the original Dave Benson radios, the RIT may decrease the available tuning range. To compensate for this, you must remove C9 and replace it with a value of 50 percent larger. Some fine tuning tinkering will no doubt be required.

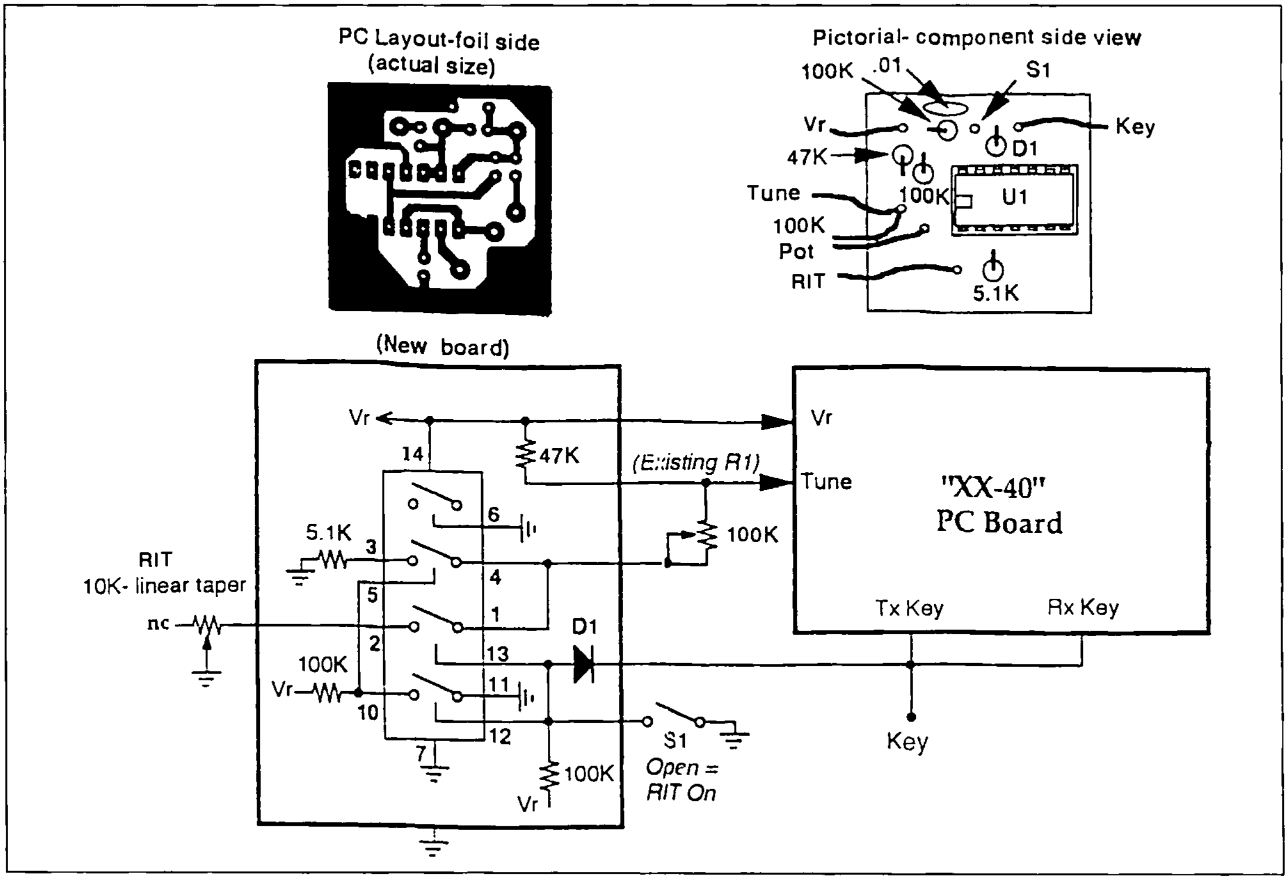


Figure 1. Circuit diagram of Dave Benson's RIT.

Building a circuit requiring a negative supply? Really want to use an audio filter but the opamps need a separate minus supply? Well, start laying out the circuit board because Linear Technology has a new CMOS voltage converter in a simple 8-pin dip IC. It's the LTC660.

This guy will source up to 100 mA while boosting a power conversion efficiency of 88% with a 100-mA load. It's simple to use. There's only two external capacitors needed. Most of the Linear Technology chips are in stock from Digi-Key electronics. Ask for one of their catalogs.

Good Books

Since the days are growing shorter, now is the time to get that old HW-8 up and running. I have a pile of the HW-8 Handbooks left. They contain modifications for the HW-8, HW-9, and a few mods for the HW-7. They're only $11 and that includes first class postage.

If the bands are dead this coming winter, then how about curling up with a good book? You can get a complete set of the *QRPP* published by the NorCal QRP club. This is great reading even if you're like Scott N8JSK who has no idea what end of the soldering iron gets hot.

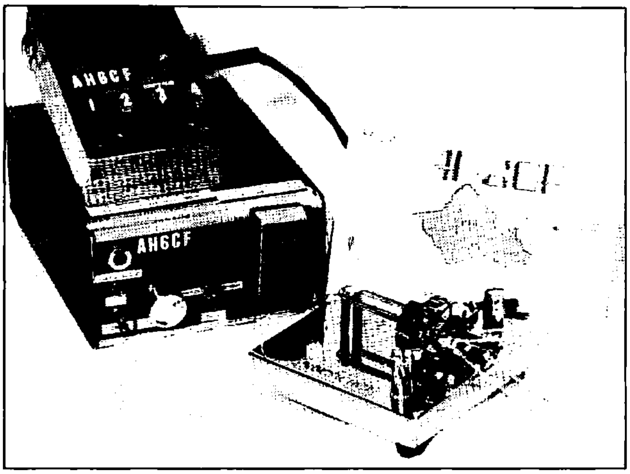


Photo A. Here is AH6CF's version of Dave's transceiver. Note the multi-turn dial for tuning.

Drop a card (with postage, please) to Doug Hendricks, KI6DS, 862 Frank Ave, Dos Palos, CA 93620. Doug has put together all the issues of *QRPP* into one huge book. This book will surely generate some all-night building binges! The price is $15.

Figuring Your Solar Needs

Most QRPers like to operate their stations on solar power. How many panels and how many batteries will it take? Instead of number crunching by hand, let your Macintosh do the work for you. I have coded a HyperCard stack that will calculate the number of solar panels, the amount of batteries required, and tell you the minimum array-to-load ratio. Why, I even figured out how to generate charts for the various reports. SunCad Lite has an extensive database of all current and out-of-production solar modules. There's also a rather busy database of lead-acid batteries to choose from. There is solar isolation data for all states (some are not active yet) as well. But, best of all, it's free! SunCad Lite requires HyperCard 2.2 and at least four Megs of RAM. If you don't have HyperCard 2.2, then ask for the stand-alone application that does not require HyperCard. Just send a Macintosh-formatted blank disk with return postage to my address. State if you want the stack or the stand-alone version. I'll send it right out to you. SunCad Lite is great fun for playing "what ifs" by changing modules or modifying your loads.

Next month, we'll look at some simple circuits to improve your low power equipment. In the mean time, everyone have a great Thanksgiving!

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Nile, IL 60714-3108

What Do *You* Want?

In last month's issue we inaugurated a new column, "Ham To Ham." In HTH we're looking for interesting ham-radio-related tips. techniques, equipment modifications. workshop shortcuts, just about anything that would be interesting information to pass on to others, young and old alike. We very much need your input to keep the column vibrant, so jot down your ideas or discoveries and send them to me at the adress above. *73 Magazine* will somehow eke out $10 for each idea that's published in this column, plus you'll be helping countless other hams worldwide who can benefit from your experiences. Every legitimate idea will be promptly acknowledged, and the author will be notified if the tip will in fact be used in an upcoming column. We're looking for original ideas and suggestions, ones that haven't been published before, which have been successfully used and can be duplicated by our readers in their own station setups.

We also invite any comments on the column as well as suggestions on its direction and content. What format would be most valuable to you, the reader? Do you want strictly technical tips or a combination of both technical and operating ideas? Is the conversational style most helpful, or should each tip be simply edited and listed individually? This is your column, so be sure to let me know how you would like to see it conducted. Your comments will be extremely helpful in making the guidelines for this new medium of information exchange within *73's* pages—let's keep it "Ham to Ham."

Too Much Trust?

We all tend to trust new parts a bit too much, I know I'm guilty of the same naiveté at times. When I set out to build or repair some item of ham gear, I inevitably assume that the new parts that I'm using are good. The vast majority of the time, that works just fine. Besides, what else can you do?

A friend of mine works for a manufacturer of electronic control panels, and they use lots of off-the-shelf electronic parts. He has come across diodes with the cathode band imprinted on the wrong end (the anode end), resistors whose color codes are mismarked and capacitors that are either misidentified, are open, or even shorted. Just about every electronic part problem possible is experienced by any large manufacturing firm dealing in electronic circuit construction.

These abnormalities happen fairly often when dealing with thousands of parts in the "real world" of electronic manufacturing. The point of all of this is that it pays to check the parts you'll be using in your next electronic project. It's so much easier to check a part before soldering it in place and it's so much wiser to eliminate any problems before applying power to the circuit, possibly damaging perfectly good parts.

The Case of The Non-Insulating Adhesives

Here's a really sneaky little gremlin that can creep into your electronic circuit boards completely unnoticed! On several troubleshooting expeditions I've encountered the adhesive used in some equipment to hold parts down on the foil side of the PC board becoming semi-conductive!

It's something that you wouldn't normally expect to happen, but it appears that some of these adhesive compounds tend to dry out over time. The condition can often be accelerated by the wide temperature variations that are encountered in mobile installations, but it can also occur in home-based equipment as well. As the adhesive dries out, it can become hydroscopic, picking up moisture from the air, which can then result in the adhesive compound itself becoming partially conductive. When bridged across the conductive pads on the foil side of a printed circuit board, this semi-conductive substance can wreak havoc on high-impedance circuits with which it comes in contact. PLL feedback loops, high-impedance oscillators and high-voltage circuits are just a couple of examples of circuitry that can be profoundly affected by semi-conductive adhesive compounds.

I've also seen a few of these adhesives apparently change molecularly, eating through the colored protective board coating and then becoming semi-conductive so that they result in high- to medium-impedance short circuits. This can occur even if the adhesive is seemingly on top of the board's insulating coating. If the adhesive mixture is slightly acidic and left unaddressed, it can eventually even etch through the copper traces themselves.

When such insulating property changes are even suspected in a piece of malfunctioning equipment, remove all of the old adhesive compound from the foil side of the board as completely as possible, and then clean up the surrounding area of the board as best you can before proceding with any other troubleshooting, being careful not to damage the board any further than it may have already been. If you choose to apply another type of adhesive on the foil side of the board, be sure to pick one that you know will not wind up presenting you with the same or similar problem down the road.

Check for Loose Screws

Over years of troubleshooting odd problems in ham-band equipment from various manufacturers, I'm still amazed at how many problems can often be solved by simply checking the tightness of the little Phillips-head screws that hold down the various individual boards in these radios. The equipment manufacturers will often use the mounting screws as pressure ground connections at the edges—or even sometimes in the middle—of a circuit board. If the board happens to have RF circuitry on it that requires a short, direct chassis ground connection, the loss of even one screw-hole pressure ground point can cause some very strange—often intermittent—problems to develop. Problems that defy most of the normal troubleshooting techniques.

I've sometimes failed to check this point myself, or a board may be hidden somewhere out of sight behind a wiring harness, and I've ended up spending many wasted hours of tracing down dead-ends, when all that I really needed to do was to make sure that those little mounting screws were snug.

Since quite often soldering flux from the factory wave-soldering machine will be deposited over the grounding pads on the foil side of these boards, there can often be times when it pays big dividends just to loosen the screws slightly, then retighten them, hopefully breaking any insulating barrier. It may not even be a total insulating barrier, just a high-resistance ground connection, but where RF is concerned, even a higher than normal resistance ground will often cause unpredictable and frustrating problems.

At times, I've had to actually clean the grounding pads with a flux remover to restore proper pressure ground connection on some PC boards. Acetone and lacquer thinner will also work, but be sure to observe the exposure precautions on the labels. The use of toothed lockwashers under the mounting screws in critical areas is also sometimes advisable, just make sure that you don't lose any of the lockwashers "somewhere in the works" when removing the screws at a later date. You can indicate which screws have lockwashers under them by a small "star" drawn next to the screw with a permanent, sharp, felt-marker pen.

So next time you experience some inexplicable problem in your radio, try the screw-tightening routine first. Good solid board-grounds are especially important in ham mobile equipment to protect against internal grounding problems due to both vibration and to the drastically changing temperature and humidity conditions often found inside of the mobile environment.

That's all for this month, but we'll be back next time with more tips, techniques, and suggestions in Ham To Ham. Don't forget to send in your ideas to the address shown above and we'll publish half-a-dozen or so of the better ones in this column each month, plus send you ten of Uncle Sam's greenbacks for your time and trouble!

73 de Dave NZ9E

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73 Magazine*, and thus no guarantee of operational success is implied. Always use your own best judgement before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73 Magazine* for any equipment damage or malfunction resulting from information supplied in this column.

NEVER SAY DIE

Continued from page 4

Don't forget what happened to the Branch Davidians when they came up against the Feds. Or Wilhelm Reich, who was thrown in prison by the FDA, where he mysteriously died. Or putting Royal Rife in prison for curing cancer, and destroying all of his amazing microscopes.

We have the makings of a pretty good country, but mass apathy and ignorance are allowing Congress and the Feds to make a real mess of things. There are plenty of books exposing what the IRS, FDA, ED, FBI, CIA, and other government agencies have been doing. We're just seeing the tips of the icebergs in the evening news.

Now let's see what you can do in designing a simple blood purifier circuit.

AIDS-Schmades

For most hams AIDS is either a very remote or a non-worry. Our homosexual brethren and sisteren probably are more interested. I'm concerned because I hate to see people dying unnecessarily early, even though it helps save our so-called Social Security system from an early collapse. That's why I've been writing about other health demoters such as fat, cigarettes, booze, and other such slow poisons.

Yes, I've been reading again. There's another book by Dr. William Douglass (*Second Opinion Newsletter*). This is on AIDS and he confirms some ridiculous rumors I've heard, but dismissed as the usual paranoia from Chicken Littles.

Douglass points out that AIDS started simultaneously in several African states, Haiti, and Brazil. Now, by a very curious coincidence, these are the same places where the World Health Organization (WHO) launched smallpox vaccine campaigns. Further, Douglass shows that the virus could not have come from animals (or a monkey), but had to have been designed and engineered for humans. In the 1972 Federation Proceedings, WHO suggested that a neat way to test immunity-suppression systems would be to introduce them via a vaccination program. Douglass says the epidemic didn't come from a monkey, it came from the labs at Fort Detrick, Maryland.

If AIDS had started, as claimed, from one monkey bite, the most cases that could be expected to have developed from that would be about 8,000, and not millions of infected people. Well, this certainly is one way to clear out a lot of Africans. And homosexuals, if that was the plan.

In New York, the head of the city blood bank set up a hepatitis vaccine study which curiously targeted males between 20 and 40 who were not monogamous. It now appears that 100% of those participating were infected with the AIDS virus. But heck, you can read the report for yourself: *Second Opinion*, 800-728-2288, $9.

In the meanwhile I've read several books by doctors claiming to cure AIDS using UV light, oxygen, herbs, and so on, and I have yet to hear from or about anyone who has failed to recover after using the simple and inexpensive blood purifier.

Slow Poison

There's a growing backlash against politically correct writing. Calling prisons "correctional institutions" is stupid. Prisons don't correct. They aren't designed or organized to correct. They're for punishment. Ditto our so-called Defense Department. It used to be the War Department, but that was back when mental hospitals were called insane asylums.

Which brings me to health care. Har-de-har. Few (if any) people will spend ten cents or spend a minute to be healthy, so there's little money in it. But when people get seriously sick, they'll spend everything they've got or can borrow to get over being sick. So, that's where the money is. Big money.

Our "health care" industry is run by doctors who haven't a clue about how to stay healthy. They're trained to look at symptoms, diagnose, and then use chemicals or knives to alleviate the symptoms, not the causes. Our medical schools don't teach health or sickness avoidance, except the use of vaccines.

One result of all this, plus the normal "I'm going to live forever" attitude, which is particularly strong with teenagers, but doesn't fade away much with age . . . at least until a big enough sickness arrives to force a reconsideration of mortality . . . is our ability to live comfortably while dosing ourselves with a whole range of slow poisons. Like what? Cigarettes, alcohol, polluted air, chlorine and fluorine in our water, magnetic radiation, negative dispositions, dental amalgam fillings, root canals, aspartame in our drinks, "recreational drugs," uppers, downers, Prozac, a Whopper & fries, even sugar . . . stuff like that. They're all slow poisons.

No, the magnetic field (EMF) radiation you get sitting next to your final amplifier isn't going to kill you soon. Neither is smoking one pack of cigarettes or snorting one line of coke. One can of Diet Coke is unlikely to kill you. Nor one Big Mac.

Yes, I'm aiming right at the heart of American culture. World culture, really. Well, how many people in their 50s do you know who are in robust health and look 20 years younger? And how many have heart disease, arthritis, bad backs, cancer, Alzheimer's, ulcers, Parkinson's, a great big fat constipated gut hanging out over their belt, emphysema, or are grossly overweight, and so on? The evidence is overwhelming that these, and virtually every other sickness, comes from our slowly poisoning ourselves.

Yes, I know about germs. You want to know more about germs? Well, do some reading. Find out what Royal Rife (*The Cancer Cure That Worked*, Barry Lynes, 1987, 168p, $16, ISBN 0-919951-30-9, Marcus Books, Box 327, Queensville, Ontario, Can. L0G 1R0, 416-478-2201), Gaston Naessens (see later), Antoine Béchamp (*Pasteur Exposed*, Ethel Hume, 1923–1989, 260p, $22, Bookreal, 8 Millar St., Denmark, WA 6333, Australia), discovered about them. In the meanwhile, consider that even in the worst of epidemics, there are some people who don't get sick. It has to do with our immune systems.

The end result of our slowly poisoning ourselves is that when I go to a reunion of my old WWII submarine crew, more than half have already died, and the rest don't look all that good. I did see a few healthy-looking old timers at Dayton, but not many. More obvious were the 11-months pregnant old men. What ever happened to that old-fashioned concept of an ounce of prevention?

If you're in your 30s, are you aiming at death in 20, 30, 40, or 70 years? Choose your poisons. There are little groups of people here and there around the world who are living healthily into their 100s. Yes, of course scientists have discovered their "secret," but I'll bet you've never read about these discoveries.

If you can stop from slowly poisoning yourself, you'll have a better chance at inflicting your crazy ideas on your great grandchildren. Your immune system starts out strong, but it eventually gets poisoned so badly that you are wide open to any bug that comes along, or it can trigger a genetic weakness. Your calcium-phosphorous ratio may swing one way or the other, depositing calcium where it hurts, or leaching it out of your bones.

In The Beginning

The human body, despite what you may believe from the Bible, has slowly developed over millions of years. It was developed to work in conjunction with the environment. I hope that makes sense. Now, think about what the environment was a hundred thousand, a million, five million years ago. Man ate food, drank water, and was exposed to sunlight. Until just a few thousand years ago man ate raw food, like all other animals. A French doctor got the totally crazy idea that maybe eating cooked food was causing some of our health problems. After all, it takes more than a few thousand years for our bodies to adapt to a major change in food like that.

So he first tested this outrageous theory on animals. What do you know, those fed raw food were healthy. Those fed cooked food got human ailments. Not being overly dumb, he then tried this radical approach to health on some dying patients. He got them to stop eating French cuisine and eat only raw food. Meat, fish, veggies, fruits, nuts. You got it, even those patients who were next to death's door started getting better. Cancer, AIDS, acne, tennis elbow, and so on. When I read about that it was almost enough to make me think. But let's not let this startling information get out. We don't want to destroy the great American food industry, right?

What would happen if everyone started eating raw food? General Mills would be demoted to Private. Battle Creek would be demoted to Skirmish Brook. We could probably close down 90% of our hospitals and senior rest homes, move the retirement age up to 92, and so on. It'll never happen. We see ever more kids starting to smoke, building a lifetime addiction to a deadly poison. Ditto beer. No, until the accumulated poisons of decades knocks people down, they'll live for today and ignore the future.

That's the way my father lived, smoking Camels for years. But he spent the last 20 years of his life (after he'd stopped smoking) suffering from emphysema. The last couple of years he had less

than 10% of his lungs still working and had to have an oxygen bottle at hand 24-hours a day.

Sure, he knew how bad cigarettes are. Even when he was young they called 'em coffin nails.

As for me, I'm shopping mostly in the organic food section of the supermarket. I load up on fruits and veggies. I do enjoy dipping veggies in some curried yogurt. Nuts, with the salt rinsed off, and raisins make a great snack. I'm fortunate to live on a farm and thus have good well water so I don't need to buy a purifier to get rid of the chlorine and fluorine most city water supplies provide. But I do add extra minerals to my water in the form of colloids. And I get out there every morning, getting those UVs into my eyes and jogging a couple miles up and down the New Hampshire hills. We have no air pollution up here. So, unless Nabisco puts out a contract on me for upsetting their poison apple cart, I may be a persistent nuisance until our hobby is folded up and our frequencies sold to the highest commercial bidder.

Like our poisoning ourselves, we'll probably lose our bands slowly, starting with the microwaves. We're not using 'em anyway, so what's the difference, right? That was the attitude toward the top two MHz of two meters in the 50s and 60s. That's when the chaps at *CQ* tried to get 146–148 MHz turned into a new CB band. Thanks, guys. And, as long as the core ARRL membership of old white men have 75m and 20m, we're not likely to hear more than a tiny peep out of the League.

Good Reading

One of the benefits of my getting away from the office and out to give talks or attend scientific conferences is the opportunity to catch up on my reading. I read in the car while Sherry drives. I read in airport lounges, while flying, and in hotel rooms in the evenings.

There are three outstanding books that I've read recently. First, there's *Maximize Immunity*, by Bruno Comby (1994, 265p, ISBN 0-9819951-11-2, Marcus Books. This is the French doctor who discovered the amazing ability of the immune system to rebuild itself, even after years of poisoning . . . by switching to raw food. This is a must read. The subtitle is, "Unleash your body's best defense against illness."

Another very exciting book is *Secrets of the Soil* by Chris Bird (1989, 444p, ISBN 0-06-091968-X, Harper & Row, $15). This book covers so many things I could write a 16-page booklet just discussing the many topics. Like using music to make plants grow, the destructive use of pesticides and chemicals on our farms and how to avoid insect destruction to organic farms. The magic of magnetized water. It's a thick book and it'll have you wearing out your highlighter. That's probably a better use of $15 than a subscription to *Radio Fun*, but barely.

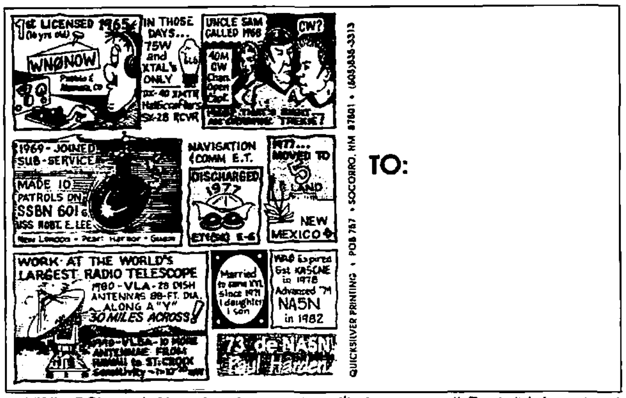
Then there's *Young Again*, by John Thomas, (1994, 384p, ISBN 1-884757-75-8, Plexus Press, Box 827, Kelso WA 98626-0072, 206-423-3168, $20). The subtitle is, "A personal guide to ageless living—How to reverse the aging process." Sounds good, eh? Well, it sounds good when you look around and half of your peers are Silent Keys and the rest are doddering on their last legs. About the only place I feel young these days is when I give a talk to a ham club and find I'm the youngest one there.

If you want to find out more about germs and how a Canadian doctor discovered how to beat the auto-immune system, making it so you'll eventually be able to avoid organ rejection after you've poisoned an organ to death and have to replace it with a borrowed one, you want to get a copy of *The Persecution and Trial of Gaston Naessens* by Chris Bird, (1991, 320p, ISBN 0-915811-30-8, H.J. Kramer, Box 1082, Tiburon CA 94920, 415-435-5367, $13). You'll also read the extent to which the Canadian medical system and the government went to stop Naessens from curing cancers.

The "health" business is just that, a business. It's all about money. When I approach AIDS workers with the news that I have a simple, inexpensive way to tackle AIDS they get all upset. AIDS is incurable, they shriek at me. Well, there are millions of dollars flowing through the medical system dependent on just that. And what would happen to the National Cancer Institute if it were known that there are some simple, inexpensive cures? I don't know which work best, or even if at all, but I have read several books recently which strongly suggest that there are some successful approaches which do not depend on chemotherapy, which has a success rate around 5%.

If I had cancer I'd run, not walk, to find out more about essi-

ac, the Canadian herbal remedy. You might want to look for Richard Thomas' *The Essiac Report*, 100p plus around 150 pages of testimonials, ISBN 0-9639818-0-3, ATIN, 1244 Ozeta Terrace, Los Angeles CA 90069, 310-278-6611, $20. I'd also get in touch with some of the medical groups working with Dr. Naessens' 714-X, as explained in the book. And what would it hurt to read Dr. Hulda Clark's book, *The Cure for All Cancers*, 1993, 511p, ISBN 0-9636328-2-5, $20, ProMotion Publishing, 10387 Friars Road #231, San Diego CA 92120, 800-231-1776. This is the book I saw featured in the window of the book store in the Edmonton (Alberta) research hospital. But then, it's your life to do with as you wish, so you can depend on your good old doctor if you want. But I'll bet he doesn't know squat about any of the alternatives to drugs, chemotherapy, and surgery.



NA5N's QSL card. Now there's a card you'll show around! Paul did the artwork himself.

The Cabal

Unless the many people I've met in the alternative medicine field are all suffering from paranoid delusions, which I doubt, there is a nasty collaboration between the AMA, the FDA, the pharmaceutical companies, and the insurance industry to maintain the status quo. Well, it's a trillion-dollar industry, so I can understand why everyone involved would be resistant to change. Any low-cost cure for a dread illness would cut revenues for everyone.

Now, if Comby is right about a totally raw food diet being able to strengthen the immune system enough so it can fight off illnesses of all kinds, and the word starts getting out, think what that could do to the whole medical industry! Oh, we'd still need a few doctors and hospitals for knife and gunshot wounds, as well as car accidents, and other emergencies. But most of the drug companies would go out of business, as well as the big food companies. So, if you think the current campaign by the electric companies to poo-poo EMF dangers is impressive, wait'll you see the number of doctors the health care and food industries can line up to warn against the dangers of eating raw food. Hey, pass me another carrot . . . they're pretty good, even without salt.

The usual serendipity brought in a copy of the Marion Dow newsletter, *CardiSense*, which had a feature article on food, pointing out that until very recently man (and woman) has eaten meat, fish, vegetables and fruits. No milk or bread products. No alcohol. And these early societies did not have "civilization diseases" such as cancer, heart disease, stroke, diabetes, and high blood pressure. You know, all those things you have.

It also pointed out that while chicken can be good food, you want to buy only free ranging chickens and not the fat-bloated chickens, doped with hormones, antibiotics, and tranquilizers, you see piled high on most supermarket counters. And steer (pardon) clear of beef, which has been specially bred to kill you with extra fat. Thank heavens for a handful of fanatics who have been pioneering organically grown foods. Wait'll you read that *Secrets of the Soil!*

All you have to do is stand near a supermarket checkout counter and watch the people going by and what they are buying to see why they look the way they do. And why you look the way you do, too.

Had Your Heart Attack Yet?

You'd better read *Left For Dead* by Dick Quinn, 1992, 200p, ISBN 0-9632839-0-1, $13, Quinn Publishing, Box 17100, Minneapolis MN 55417, 800-283-3998. Dick had his heart attack and had the usual by-pass surgery. But it didn't help him, so his doctor wanted to do a few more. Then Dick found out about cayenne pepper and cured himself and everyone he could talk to. You should read his book. If you do, you'll be looking around for cayenne pepper too. Hey, it only burns twice.

It wouldn't hurt to look for a good book or two on chelation. I was suspicious of it at first, but the more I've read, the more it looks like a good approach to getting your arteries cleaned out. Check out *Forty Something Forever*, by Harold & Arline Brecher, subtitled "A consumer's guide to chelation therapy and other heart-savers," 1992, 377p, ISBN 0927839-46-6, $7, Healthsavers Press, Box 683, Herndon VA 22070, 703-471-4734.

And if you think I'm exaggerating about the medical establishment fighting anything new or different, you want to read, *Racketeering In Medicine*, by Dr. James Carter, 1992, 363p, ISBN 1-878901-32-X, $13, Hampton Roads Publishing, 891 Norfolk Square, Norfolk VA 23502, 804-459-2453. Read about how the medical establishment, hand-in-hand with the FDA, has done a job on acupuncture, nutrition, chelation, chiropractic, homeopathy, osteopathy, etc.

Anyway, I highly recommend you read Dick's book before you have your heart attack and a series of mostly useless by-passes.

Real Research Needed

I don't know which of the endless nostrums I get promotions about in the mail are worthwhile and which aren't. But I also haven't seen any sign that our medical establishment is making any effort to check them out.

Oh, I can understand. The worst nightmare for the National Cancer Institute would be a cancer cure. And what would happen to the $200 billion pharmaceutical industry if raw food really does prevent almost all illnesses, and we're somehow able to convince people to eat it? So, when I read about doctors having success with alternative approaches, complete with endless testimonials from people who were at death's

door, I want to know more, and cut the self-serving baloney.

How efficacious are chlorella, saw palmetto, echinacea, kombacha, ginger, garlic, cayenne, hydrogen peroxide, chromium picolinate, silver colloids, ginkgo biloba, ginseng, gero vita, and so on? The National Institute of Health (NIH) has set up a department to check out these and all the other nostrums, but I haven't seen any sign of action yet.

If you find any books you think I should read, please let me know. And I'll keep passing along the titles of those I've found which have impressed me the most favorably.

Chef Green

Now that I've shifted to a largely raw food diet after reading the Comby book, I've been digging up some of my family's old recipes. This is a simple one for cole slaw that's the best you ever tasted. I've had a lot of cole slaw shoved at me in restaurants, but none has ever come close to my grandmother's old recipe. Give it a try, it's a beaut.

First shred some raw cabbage. Maybe a quarter of a cabbage. Be careful of your fingers. I took a thin slice off the ends of two of mine the first time I shredded. Mix 2T olive oil, 2T apple cider vinegar, 1T sugar, 1/2t salt, 1/8t pepper, 1/2t celery seeds, 2T mayonnaise, 6T sour cream. Whip it all together and mix into the shredded cabbage. T = tablespoon; t = teaspoon, but you knew that.

Maybe you'd better make a double batch. It won't last long. And yes, you can use reduced fat mayonnaise and sour cream. I do. Or even yogurt. This also makes a great dip for raw veggies.

QSL Contest Resuscitated

Good grief, you should see some of the crappy QSL cards I've been getting. Remember, you only have one chance to make a good second impression. Your first opportunity was in how interesting you made the contact for the other chap. Did you get him to talk about himself at length? And about more than his rig, antenna, and the weather? Your second chance is your QSL. How distinctive and interesting is it? Is it one he'll put up where visitors can see? Will he show it around? Well, why the heck not? Oh, you're too lazy to think, is that it? There goes Wayne, asking you to think! Just take a look at the story on the back of NA5N's card. Now there's a card you'll show around! Paul did the artwork himself. And if you get one of my cards I guarantee you'll be showing it to everyone. If I get one of yours, what'll I do? Flip it into the box with a thousand others?

You are an individual, despite your teenage efforts to be like everyone else, so get to thinking about how you are different and see if you can build that into your card. Even my business card is different. Heck, I know you're not going to believe this, but I used very small type and put a sort of mini-biography on my card. No one forgets it, and it provides lots of interesting conversations. No, I didn't list everything I'm interested in, that would take a book. Just the biggies like cold fusion, hamming, scuba diving, skiing, gourmet cooking, and stuff like that.

Now get out a pencil and paper and start designing a QSL card that will let me know about *you*. If you can't draw any better than I, then find a friend who can and get him to do your artwork. Make me remember your card.

And when you have a winner, send it in to the *73* QSL Contest and see if you can win. Or at least get honorable mention. Winners get an extra year of *73* and the runners up will win their choice of one of my fabulous CDs.

Aspen Ham Conference

If you ski, and if there's enough snow, could I get you and your wife to take off a few days in early January to get together with me in Aspen for some skiing, ham talk, and general conversation? I'm ready to both pontificate and listen on alternative health, solving our many social problems, religion, ham radio's future, cold fusion developments, cosmology, skin diving, and so on. It's a ball to ski down the slopes of Buttermilk/Tiehack, Aspen Highlands, and Snowmass, with interesting people to talk with on the lifts and over lunch on top of a mountain. I'm a good intermediate skier, so I can probably keep up with you. And we can rap at any of the fabulous Aspen restaurants over dinner.

The rich and famous may be all over the place, but it really doesn't cost a lot to stay there, and over 70 you ski free. Heh, heh. I've been going there since I first learned to ski in 1966, when I was in my 40s.

So let's get some adventure into your life. I'm planning on being there January 4–11th, which is the economy season, right after the holidays, when there are usually short (if any) lift lines and wide open slopes. ■

HOMING IN

Number 24 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KOOV
P.O. Box 2508
Fullerton, CA 92633

Cooperative Tracking and Web Surfing

"No Clues!" That's the admonition you'll hear if you transmit any useful information during a southern California hidden transmitter hunt. During these mobile radio direction finding (RDF) contests, which are usually called T-hunts or foxhunts, the hunters in each vehicle compete against all the others. Each team wants to be first to find the signal source, or to find it with low mileage, depending on the rules.

Long-time T-hunters never forget that they are in a contest. When they encounter their opponents along the way, they aren't above committing some friendly prevarication or spreading disinformation to throw them off the trail. "Never trust another T-hunter" is a maxim heard often. It's all in good fun, of course.

One Big Team

Sometimes, the rivalry has to be put aside. When a jammer or stuck carrier makes your repeater useless, or when a station in distress must be located, it's important to know how to perform cooperative RDF. T-hunting can teach that, too. In years past, one of the most popular scheduled southern California hunts was sponsored by the Mount Wilson Repeater Association (MWRA). When the hidden station appeared on the repeater input, base stations and T-hunting mobiles throughout the repeater's wide coverage area began to report their bearings and signal-strength indications for all to hear. Some base stations used computer programs to triangulate all the bearings and deduce the most likely coordinates of the hider. The mobiles would zoom down the freeways to that location and close in.

With several mountain ranges and urban areas within the hunt boundaries, the bearings seldom agreed fully and the triangulation was hardly ever perfect; however, it was great fun and excellent practice for emergency RDF. Two winners were declared for each MWRA hunt: the mobile team that first found the T, and the mobile or base station that reported the most accurate initial bearing. Hiders faced a special challenge. Whereas on most clubs' hunts it is only necessary for the transmissions to fool hunters at a single starting point, this event demanded a deceptive signal all over the repeater's coverage area.

April (WA6OPS) and I have stumped the MWRA hunters, but only once. We put a very low power transmitter on the side of a high hill that faced the repeater. With a long beam, we achieved a full-quieting signal into the repeater, but the mobiles couldn't hear it at all and the base stations couldn't hear it well enough to get good bearings, thanks to the hill behind the T. We egged them on by talking to them via a remote 2 meter station on a different mountain, dozens of miles away. They could hear this remote on the repeater input, of course, but it was a diversion, not an aid. After about four hours, they all gave up.

MWRA hunts have not been held for several years, but cooperative hunting is alive and well elsewhere. The Snohomish County RACES T-hunters tried it on 2 meter simplex in the mountains of western Washington state this summer. RACES RDF coordinator Jim Bowman W7HPK reports that they planned ahead to make these hunts effective practice for rapid wilderness rescues.

The first hunt was in June, when the T turned out to be close to a narrow mountain logging road with deep ruts and thick brush overhanging both sides. At the beginning, the seven teams split into two main groups, one starting out east and the other going west. Eventually one team went up the foreboding road, found the T, and everyone gathered for a picnic.

A month later it was Jim's turn to hide. The lessons learned a month before led to better organization and preparedness. This time, the seven teams were assigned tactical designators such as Blue Team and White Team. By using these tactical calls (as well as ham calls at FCC-required intervals), it was easier for teams to keep track of one another, no matter which team member was at the mike. Detailed ranger district maps were provided for all. Teams attempted to keep in touch with one another on 440 MHz FM simplex. Knowing that this band can be difficult in the mountains, some teams had 75 meter sideband as a backup.

"Charles Scharlau NZ0I volunteered to serve as the Resource Station," Jim reported. "He tried to find a good stationary location from which to monitor the progress of the hunt and to keep track of where the teams were, what roads had been checked out, and what bearings had been taken and from where. Then he would inform the various teams as appropriate."

Photo A. Most Roanoke Doppler builders who choose the one-piece antenna system mount it on their vehicle roof with suction cups. Ken Thompson NØITL did it differently (photo by NØITL).

Unfortunately, NZØI's preselected location was based on a bad guess. It turned out to be 12 miles and several mountain peaks away from the hiders, making communications difficult as they closed in. Despite this problem and the momentary terror when one vehicle's brakes failed on a steep narrow road, Jim reported that everyone enjoyed themselves and cooperative hunts will continue in the future.

Let Mother Nature Hide

Compared to Snohomish County, the T-hunt policy around Wichita, Kansas could best be described as "partial cooperation." Ken Thompson NØITL reports that T-hunters there are regularly called upon to recover equipment from high-altitude amateur television (ATV) balloon launches.

Nowadays, most high-dollar ham balloon payloads incorporate a Global Positioning System (GPS) receiver to report its exact location throughout the flight. If that feature works, RDF isn't needed for recovery after the balloon bursts and the package drops to earth. "I developed software that takes the GPS information from the balloon and from my car, then combines the data streams on one serial port," Ken says. "It will plot my path, the path of the balloon, and the distance and bearing to the balloon from the car. It keeps track of everything in real time."

Since a sensitive GPS receiver might not survive the shock, temperature, and altitude extremes of a flight into the stratosphere and back, Wichita ATV balloon enthusiasts include a backup 2 meter beacon in the payload. According to NØITL, "At the heart of it is a crystal oscillator for a computer video card at 29 MHz. The output is processed to peak the fifth harmonic, which goes to a wire antenna. A lithium battery provides power and a PIC microcontroller provides CW identification."

Just for fun and to practice for wayward balloons, Ken and his T-hunting friends like to put up these little beacons without the rest of the ATV equipment. "Every couple of months we get itching to do it," he says. "We put the transmitter and battery in styrofoam insulation and launch it under a six-foot helium party balloon that costs five dollars at the local card store. The whole payload is about the size of two fists. On the ground, you can hear it maybe half a mile away. Up

in the air, it can be heard for thirty miles or so. It probably achieves almost forty-thousand feet in altitude and stays up one and a half to two hours. We had one travel about fifty miles and land in the middle of the Flint Hills. It's cattle country, where there's a barbed-wire fence about every three miles and no roads.

"With no parachute, it generally takes about fifteen minutes to crash after the balloon bursts," NØITL continues. "We can tell when the signal goes on and off and flutters that it's coming down, and we have only about a quarter hour to get within a mile of it or we'll lose it. At that point, it turns into kind of a free-for-all hunt. We talk to each other on 440, telling what town we're in and what direction we're hearing it from. I'm proud to say I'm usually first on the scene, which has to do partially with my Doppler and also with my ability to interpret its display well. But I also drive pretty fast."

NOITL prefers his Roanoke Doppler RDF set over the beam-and-S-meter method for this kind of hunting. His mounting system for the four-whip Doppler antenna is unique (see Photo A). "I wanted to preserve the finish on my car," he told me. "A three-quarter-inch bolt is welded to a heavy gas pipe for the mast. It goes up to a four-by-four-inch plate with eight quarter-inch rods welded to a ring of angle iron that the plywood base bolts to. There are clear plastic three-eighths-inch beads on all the vertical and radial elements for eye protection. The system is solid, but it comes apart in two pieces for storage. I remove the glass mount whip antenna in the rear window when hunting so that it won't affect the bearings."

NØITL says that the preparation and practicing of Wichita T-hunters paid off this summer when thunderstorm warnings activated hams for possible tornado spotting. "Suddenly, we had a stuck transmitter to find. A carrier with white noise was on our RACES repeater input. It was stronger over here on the east side of town, so all the guys with Dopplers took off. We ended up in the next county about 30 miles east. A ham was using a dual-band mobile unit as a base station in his house. While he was out storm spotting for his county, something happened and the radio locked on in the crossband repeater mode. It took us about a half hour, but we drove right to it."

Worth Browsing For

As a general rule, I've found that T-hunters like learning, building, and experimenting with new technologies. It's no surprise, therefore, that most are computer literate and a high percentage seem to be on packet and the Internet. Personal E-mail and the "fox-list" mailing list have alerted me to much of the T-hunting news in this column for the past few months. So it's no surprise that World Wide Web sites for RDF enthusiasts are starting to appear.

The biggest and best Web source of T-hunting information I have found so far is maintained by Brett Coningham AB5P. He lives in Albuquerque, New Mexico, a city second to none when it comes to enthusiasm for mobile transmitter-chasing contests (see Photo B). "I use an Internet service provider here in town," says Brett. "Storage for the page files is all provided and they have a UNIX Web server that does all the work, so it's really easy for me. I develop the pages at home, then I log in and copy the files directly onto a directory area on the system. The UNIX computer does the rest."

When you log on to Brett's home page, you'll find a directory of articles telling about the way T-hunting is done in Albuquerque, when the hunts are, and what equipment the hunters prefer there. Everything is written with a twinkle in the eye and a tongue in the cheek. If you're like me, you'll laugh out loud when you read about the plusses and minuses of "Binford Beams," which were named after the famous testosterone-laden "Tool Time" products on ABC-TV's "Home Improvement."

Click to another page and you'll find "T-hunt Bloopers," with a half-dozen tales (as of this writing) of hides and hunts gone awry. One of my favorites is about the mobile RDFers who got their coax cables mixed up in the middle of a hunt and accidentally connected two VHF radios together instead of to their respective antennas. There are also stories of legendary hiding feats such as the rotating beam hunt of Kevin Kelly N6QAB (see Photo C).

"Having the site has been fun," says AB5P. "I've gotten a lot of E-mail about it. I had 2500 log-ins last month, from at least a couple dozen countries. I plan to add more pages as time goes by. I want to scan in some photos of our hunts so people can get a better idea of what it looks like."

A visit to Brett's home page made me glad I went through the trials and tribulations of getting my Web browser software installed and working. (It wasn't easy.) By the way, no parental control is necessary, because AB5P's pages are all G-rated, and the G stands for "giggles."

Photo B. Weekend transmitter hunts in Albuquerque attract good attendance. They start at 9 AM on the first Saturday and third Sunday of each month in a parking lot on the University of New Mexico campus.

Lost in Cyberspace

I've read that in spite of its reputation, the US Postal Service is still more reliable than E-mail for getting messages through. I didn't believe it until a couple of weeks ago, when my E-mail volume dropped to 10% of normal. The next day, there was even less, then it stopped completely. It took me eight days to find the technician at America Online who could solve the service's technical problem and re-establish my incoming mail. (Thanks, Kenny!) Meanwhile, readers who sent E-mail to me got no "Message Undeliverable" replies to tell them that their letters weren't getting through.

Many of my incoming messages were later recovered, but about 140 were lost during that time. So if you sent E-mail to me in late August expecting a reply and you didn't get one, please try again. I still think E-mail is more convenient than postal mail, but I'm not ready to pay my bills via Internet yet.

Resources in This Article

Plans for the Roanoke Doppler RDF set used by Wichita hunters can be found in "Transmitter Hunting—Radio Direction Finding Simplified," by Joe Moell KØOV and Tom Curlee WB6UZZ. This 323-page reference book (TAB/McGraw-Hill #2701) covers all aspects of RDF and is available from Uncle Wayne's Bookstore. Antenna system improvements are in "Homing In" for April and June 1995.

The URL address for AB5P's T-hunt World Wide Web site is @internet:http://swcp.com/~ab5p/foxhunt.html.

To subscribe to fox-list, the worldwide Internet T-hunt mailing list of the Boston Amateur Radio Club, send a one-line E-mail message to listserv@netcom.com with the text "subscribe fox-list" (without quote marks). The subject line is ignored. You will begin to receive all messages addressed to the list and you will get E-mail explaining how to post and unsubscribe. Note that there is a hyphen in "fox-list," but not in "listserv."

KØOV's E-mail address is HomingIn@aol.com. CompuServe users can send mail to 75236.2165

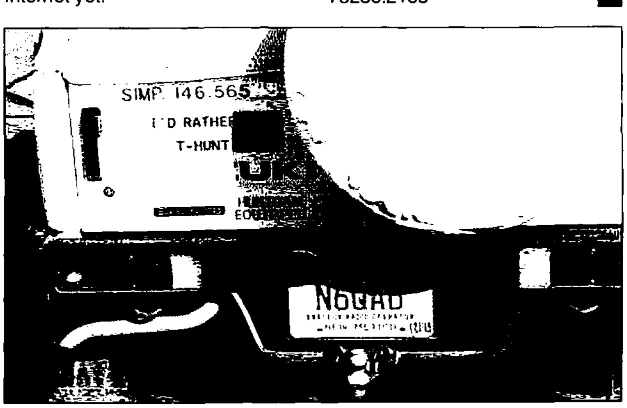


Photo C. Kevin Kelly N6QAB lived in Albuquerque only a short time, but he helped T-hunting become a regular activity there. His unusual hiding tricks, such as the "rotating beam hunt," are legendary.

Number 25 on your Feedback card

SPECIAL EVENTS

Ham Doings Around the World

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

NOV 4

GODFREY, ILL The Lewis & Clark Radio Club will host the Midwest Amateur Radio Expo 8 AM-2 PM at the Riverbend Arena, Lewis and Clark Comm. College. VE Exams, pre-reg. by calling *Richard Morgan, (618) 466-2306.* For general info. call *Harold Elmore, (618) 466-1909.* For Flea Market spaces, tables, contact *Larry Roberts, (618) 466-0041.*

ENID, OK The Enid Hamfest Group will sponsor a Hamfest 8 AM-5 PM at Garfield Co. Fairgrounds, Oxford and 4th Sts. Talk-in on 147.375(+), and 444.825(+). VE Exams at 1 PM. Covered Dish Banquet at 7 PM. Contact *Tom Worth N5LWT, days or eves. at (405) 233-84733;* or write to him at *2302 Eucalyptus Ave., Enid OK 73701.* Internet e-mail *EnidARC @aol.com - ATTN: TOM.* This event is listed under HAMFEST *.

EUSTIS, FL The 1995 Lake County Hamfest and Electronics Expo will be hosted by the Lake ARA, 9 AM-5 PM at Lake County Fairgrounds. W5YI VE Exams start at 11:30 AM, walk-ins welcome. ATV and Packet demos. Talk-in on 147.255 or 442.900. Contact *Tony Summerlin KE4NLG, (904) 787-1449.* Make checks payable to *L.A.R.A.* and send with SASE to *L.A.R.A., c/o Tim Morrison, P.O. Box 881, Tavares FL 32778.* Last mail out will be Oct. 15th.

LAKE WORTH, FL The West Palm Beach ARC will present a Free Flea in John Prince Park, 8 AM-2 PM. Talk-in on 147.135(+) or 146.670(-). Contact *Marvin Kaskawits KD2CK@KB4VOL at (407) 683-2930;* or *p001471b @pblreenet.seflin.lib.fl.us.*

NOV 5

KAUKAUNA, WI The Fox Cities ARC Hamfest will be held at the Starlite Club on the corner of 55 and JJ. Doors open at 8 AM. Talk-in on 146.76 pl 100. For info, write *FCARC, 2410 E. Newberry Ct., Appleton WI 54915:* or call *Dan Vanevenhoven, (414) 739-5101.*

NOV 11

MONTGOMERY, AL The Montgomery ARC will host the 18th annual Montgomery Hamfest/Computer Show in Garrett Coliseum at the South Alabama State Fairgrounds on Federal Drive. Flea Market setup 3 PM to 8 PM Fri., Nov. 10th; and 6 AM-8 AM Sat., Nov. 11th. Doors open 8 AM-3 PM CST. VE Exams on-site starting at 8 AM. Bring original and a copy of your current license, picture ID, and $3. Talk-in on 146.24/.84. call W4AP. Ragchew on 146.32/.92, with phone patch. 'up/#down). 147.78/.18, 449.50/444.50. Please reserve Flea Market spaces early; call (after 5 PM), *Steve, (334) 270-0536: FAX (334) 264-1150;* or write to *Hamfest Tables, c/o 2736 W. Aberdeen Dr., Montgomery AL 36116.* Special Hamfest rates at *Statehouse Inn, 1-800-552-7099.* For more info, write to *Hamfest Committee, c/o 2141 Edinburgh Dr., Montgomery AL 36116-1313;* or phone *Phil* at *(334) 272-7980;* or *FAX (334) 264-1150.*

MYRTLE BEACH, SC The Grand Strand ARC will present a Hamfest, 9 AM-4 PM, at Myrtle Beach H.S., Central Dr., between 29th and 38th Aves. N. VE Exams at Noon; call *Les Shattuck, (803) 236-3036.* Talk-in on 145.11. For reservations, contact *David C. Berry KE4DOW, Grand Strand ARC, P.O. Box 2135, Myrtle Beach SC 29578-2135. Tel. (803) 248-9401.*

NOV 12

BRANFORD, CT The SouthCentral Conn. ARA will hold its 16th annual Flea Market at the Branford Intermediate School, 185 Damascus Rd. Sellers 7 AM, Buyers 9 AM. Talk-in on 146.01/.61. VE Exams, reservations no later than Nov. 1st. None by phone. Info or reservations, SASE to *SCARA, P.O. Box 705, Branford CT 06405-0705.* For info, call *Brad, (203) 265-9983, 24 hrs.*

CARTHAGE, MO The Carthage ARS will sponsor a Hamfest, 8 AM-1 PM, at Memorial Hall, Garrison and Oak Sts. Setup 5 AM-8 AM. Talk-in on 147.42 MHz simplex. Contact *Jim Dixon WX0J at (417) 358-2761;* or write *P.O. Box 783, Carthage MO 64836.*

NOV 18-19

FORT WAYNE, IN The Fort Wayne Hamfest and Computer Expo/1995 Indiana ARRL State Convention, will be held at Allen County War Memorial Coliseum Expo Center Sat., 9 AM-4 PM EST; Sun., 9 AM-3 PM, EST. Setup is Fri. eve. and Sat. morning. VE Exams. Forums. Ladies Events. Presentations by Gordon West WB6NOA. Shuttle bus service provided. For more info, contact *John Rufner KB9BNI, (219) 483-6305 (tables);* or *Don Gagnon WB8HQS, (219) 484-3317 (info).* Or, write to *ACARTS, P.O. Box 10342, Fort Wayne IN 46851.* Sponsor: Allen County AR Technical Soc., Inc.

TAMPA, FL The 20th annual Suncoast Amateur Radio/Computer Convention will be held by the Florida Gulf Coast AR Council, at Florida Expo Park, Expo Hall. For more info, call *(813) 525-5178,* or write *Jean Endicott, 1556 56th Ave. North, St. Petersburg FL 33703.*

NOV 19

BENSON, NC The Johnston ARS., Inc. JARSFEST95 will be held 8 AM-4 PM at the Americal Legion Complex on Hwy. 301 N. For info, contact *Bill Lambert AK4H, 8917 Hwy. 50 N., Benson NC 27504. Tel. (919) 894-3352 eves. 7 PM-10 PM.* Talk-in on 147.270(+). VE Exams begin 10 AM sharp, courtesy of RARS VE Team. Pre-reg. until Nov. 13th. Send completed Form 610, photocopy of your current license (if applicable), indicate the highest class of license you desire to be tested for: and send a check or m.o. for $5.90 payable to *JARS,* to *Vince Yakamavich AA4MY, 220 Carriage Trail, Raleigh NC 27614. Tel. (919) 847-8512* for exam info. To reserve space, call *(919) 894-3352, 894-3100, and 894-5479, 7 PM-10 PM.*

NOV 19-20

TAMPA, FL The Suncoast Amateur Radio/Computer Convention will be held by the Florida Gulf Coast ARC at Florida Expo Park Expo Hall, starting Sat. at 7 AM. Expo hall opens 9 AM. CW Contest at 12 Noon. NTS Traffic Forum at 1 PM. There will also be an ARRL Forum and ARES Forum. Gate opens at 7 AM on Sun., Expo Hall opens at 9 AM. Activities include Basic Packet by Paul Evans, APRS demo, Hidden Transmitter Hunt, Antenna building workshop, and more. For more details, contact *Jean Endicott, 1556 56th Ave. North, St. Petersburg FL 33703. Tel. (813) 525-5178.*

NOV 25

EVANSVILLE, IN The 3rd annual E.A.R.S. Evansville Winter Hamfest will be held 8 AM-2 PM, Central Time, at Vanderburgh County Fairgrounds (US 41, at Boonville-New Harmeny Rd.—between I-64 and Evansville). Setup begins at 6 AM. Talk-in on EARS Rptr. Net, 145.150(-) Evansville; 146.925(-) Vincennes. Alternate: EARS Rptr. 145.110(-). For reservations or info, contact *Neil WB9VPG, (812) 479-5741,* or write *EARS, 1506 S. Parker Dr., Evansville IN 47714.*

SPECIAL EVENT STATIONS

NOV 4-5

MUSKEGON, MI The Muskegon Area ARC will operate W8ZHO 1800Z Nov. 4th-1200Z Nov. 5th, from aboard the USS Silversides. General 40-20m, phone, and CW. For a certificate, write to *Robert Carter WB8OQT, P.O. Box 691, Muskegon MI 49443.*

NOV 6-7

ELLENVILLE, NY Amateur radio operators from the Science Teachers Assn. of NY State, will operate KB2JDB 1400Z-2200Z Nov. 6th and 7th, to demonstrate amateur radio to science teachers, and commemorate the 100th Anniversary of the organization. Operation will be in the General and Novice portions of the 80 to 10 meter subbands. For a certificate, send QSL and an SASE to *Jim Kuhl N2SPK, Central Square Middle School, 1150 US Rt 11, Central Square NY 13036.*

NOV 6-9

GUELPH, ONT. CANADA Between Nov. 6th and Nov. 9th, the Guelph ARC will operate VG3W from the McCrae House Museum, to commemorate the 80th Anniversary of Col. John McCrae's writing of the WW1 poem "In Flanders Fields." This is also the 50th Anniversary of the liberation of Europe in WWII. Nov. 11th is called Rememberance Day, or Poppy Day in Canada. VG3W will operate on all bands from 1500Z-2200Z. QSL via *VE3ZM, Guelph ARC, P.O. Box 1305, Guelph Ontario, Canada N1H 6H9.* Please send Canadian postage, 1 IRC, or one Green Stamp.

NOV 11-12

BELLEVILLE, NJ The Irvington-Roseland AC will operate K2GQ, 1400Z-2100Z to commemorate the club's 50th Anniversary. Operation will be in the General portion of the 80m-15m bands, the Novice portion of the 10m band, and on 146.52 FM. For a certificate, send QSL and SASE, or 1 Green Stamp, to *Bill Fitzsimmons N2LMU, 102 Cedar Hill Ave., Belleville NJ 07109.*

FORT KNOX, KY The Lincoln Trail ARC will operate the 3rd annual Veteran's Day SE Station, KR4CW, from the Army MARS station, to commemorate those who have served our country. The Station will operate in the Novice 10 meter and the General area of 15, 40, and 80 meters, SSB and CW. Send QSL and SASE to *LTARC, P.O. Box 342, Vine Grove KY 40175,* to receive an 8 1/2" x 11" color certificate.

NOV 18

JACKSONVILLE, NC Get a certificate for working a club station in Turkey (NC). For the club's annual observance of Thanksgiving, the Onslow ARC will operate WD4FVO from the grounds of the Cabin Museum just outside of Turkey NC. OARC's "Turkey Talk" is a day long field event. The club will operate both HF and VHF stations on CW, SSB, and packet, 9 AM-4 PM EST. Listen in the Novice and General CW and voice portions of HF bands 80-10 meters. Send the club an SASE for a certificate suitable for framing. Contact *Onslo ARC, P.O. Box 841, Jacksonville NC 28541-0841.*

PROPAGATION

Number 27 on your Feedback card

Jim Gray W1XU

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Conditions This Month

Cycle 22 continues to amaze . . . and while the sunspot numbers continue to decline, the solar flux level refuses to follow along, and has remained rather steady since spring. The solar minimum is still likely to occur sometime during 1996, in my opinion, but the flux remains quite stubborn. I think that "conditions," therefore, ought to remain just a bit better than expected for the next few months.

The *worst* days for propagation (and perhaps other geophysical conditions) are likely to occur in late October and continue until the middle of the second week of this month. The chart shows VP (Very Poor) for the 1st and the 4th, and P (Poor) for the 2nd, 3rd, and 5th, followed by gradual improvement for the remainder of the month. The best days (G) should be the 9th through the 12th, 16th through the 19th, and 26th through the 30th. The remaining days in between will trend from Good to Fair or vice versa.

10 and 12 Meter Bands

Not expected to be very good, but still should be monitored for transequatorial/tropical paths during the daylight hours.

15 and 17 Meter Bands

Similar in overall outlook to 10 and 12 Meters, but with better chances to work DX because of the outright popularity of these bands throughout our worldwide community.

20 Meter Bands

This is your workhorse band for worldwide DX during the daylight hours this month, with occasional openings beyond local time sunset, moving from east to west, and long skip north and south.

40 Meter Bands

DX on this band should be available from just before sunset until just after sunrise, which also means broadcast station interference in the phone portion of the band. Concentrate on the days marked fair or even poor, as conditions on the higher bands (which should still be checked) may make them unusable.

80 and 160 Meter Bands

Expect some fairly good DX and short-skip openings during the hours of darkness, which will lengthen the time we will be able to pursue our pastime!

VLF (1601–90 kHz.)

Anyone with interesting happenings in this portion of the spectrum is invited to contact me. I'd like to receive data regarding conditions over a period of time—that is, fair, improving to very good over a period of days, and vice versa, with signal levels, distances worked, time of day, etc.

Please let me know how these forecasts are working for you. See you next month. Jim W1XU.

NOVEMBER 1995

SUN	MON	TUE	WED	THU	FRI	SAT
			1 V-P	2 P	3 P	4 VP
5 P	6 P-F	7 F	8 F-G	9 G	10 G	11 G
12 G	13 G-F	14 F	15 F-G	16 G	17 G	18 G
19 G	20 G-F	21 F	22 F-G	23 G-F	24 F	25 F-G
26 G	27 G	28 G	29 G	30 G		

KEY

VG ....Very Good	P ....Poor
G ....Good	VP ....Very Poor
F ....Fair	

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

Letters Continued from page 6

megahertz of the former 2-meter ham band?" I can just hear it!

We in Indiana are not experiencing the problems (to the extent described) that the ARRL is suggesting.

I'm not saying that there are *no* problems associated with the job of frequency coordination, and I am certainly understanding that some states might need enforcement help. But why are you going to let the ARRL get involved in your job? There are other alternatives, such as calling on other state Frequency Coordinators, talking to other hams, talking to your wife, and maybe calling a priest, but don't rely on the ARRL to do the right thing for you! It probably won't happen. They (the ARRL) are too mired in the politics of the federal government lobby, the FCC, and the apparently intoxicating effects of being that close to power over the masses (that's you, fellow ham operator!). They've got too much money, and it just gets down to this: they probably just don't give a damn what you (or I) think anyway. I would hope that in my lifetime, my attitude towards them (the ARRL) would change for the better, but I don't know if I'll live that long!

We (the Indiana Repeater Council) have just had a "changing-of-the-guard" in the executive staff. They are thoughtful, intelligent, and committed to the task of frequency coordination and all that it entails. We're working on a new set of band-plan proposals utilizing 15 kHz spacing (for the most part) that will allow many more frequencies to be properly coordinated in the 29, 50, 144, 222, and 440 bands. That is, if the membership and the adjacent states want to adopt them. The plans also include very viable suggestions for where to put those dual-band, cross-band repeating-transceivers into operation for the best results and the least congestion and interference. After that, we're going to tackle the job of suggesting new plans for the 900- and 1200-MHz bands that favor utilization of more modern modes of transmission, such as CDMA, TDMA, T-1, and the like. Our mindset is that of trying to move amateur radio relay techniques forward to the point where we should be already . . . in the leadership position, not the slackers' corner! The executive board of the IRC has also endorsed a new set of technical transmitter adjustment suggestions for repeaters, auxiliary stations, and users. We have a fine crew to handle the job of frequency coordination in the State of Indiana. Please note that we (the IRC) know our place . . . we are not a dictatorial organization . . . we are in the business of making *suggestions* and offering help. We are *recognized* by the local and regional ham-radio population, and that is where we draw our strengths and maintain our identity. We do *not* need further laws, and rules, and regulations, and financial support burdens to be more legitimate. We're doing just fine out here in the cornfields of Indiana, thank you! We believe in a simple idea, "if it ain't broke, don't fix it!"

If you would like us to share our ideas with you, just ask! Our address is:

Indiana Repeater Council, c/o Cass Co. ARC, P.O. Box 1092, Logansport, IN 46947.

73, Jim KK9T.

NEW PRODUCTS

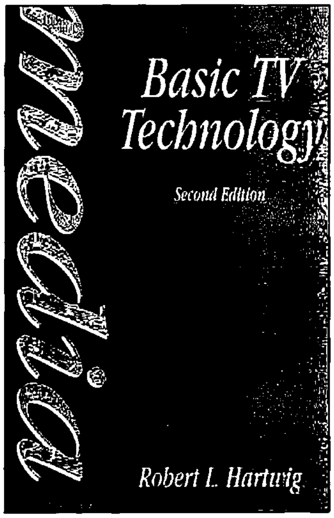
Compiled by Wayne Green W2NSD/1

RF Industries

RF Industries has just released its RFA-4027 SMA Technician's Adapter Kit, which fits the 13 most popular SMA adapters and contains both in-series and between-series adapters, satisfying most adapter requirements. They're housed in a zippered leatherette case which lies flat when fully opened. All adapter sections are nickel-plated, machined brass with gold-plated contacts in Teflon dielectric. For more information, contact: *RF Industries, 7610 Miramar Rd., San Diego, CA 92126-4202; (619) 549-6340, (800) 233-1728, fax: (619) 549-6345.* Or circle Reader Service No. 201.

Octavia—Box 88 Opened

The whole Russian callbook, including all the previous Soviet Republics, is now available on two 3.5" floppies for your PC (no Mac). There are more than 50,000 hams and their addresses listed, many with their home phone numbers. You can update the list, even add notes when you make a contact. The list is updated twice a year (April and October). It's available for $25, plus $3 shipping by air (money orders, no checks) from *Jan Bexner SM7DEW, Villa Dalen Berghem, S-34191 Ljungby, Sweden.* Or circle Reader Service No. 202.



Basic TV Technology

Focal Press has a new 172p $20 paperback edition (2nd) which will help you understand how TV works. It starts out with the most basic of fundamentals, with the end result that you'll finally have a good grasp of the subject. Alas, there's no index (tsk!), and it doesn't go into compression technology like MPEG.

Circle Reader Service No. 203.

Gordon West Advanced Book Now Updated

Amateur radio operators wishing to upgrade to Advanced class may now obtain the new, updated Advanced class FCC license preparation book, written by well-known instructor, Gordon West WB6NOA. The new book covers all 582 Element 4A questions and answers, with four possible answers and West's unique explanation for every question.

The first 20 pages are devoted to bringing the licensed radio amateur up to date on recent changes within the amateur radio service. Chapter 3 specifically guides the radio amateur through testing procedures for the Advanced class exam. The book explains exactly what to bring to the VE test session. It also contains tear-out pages of formulas.

The book is available through leading amateur radio dealers and all Radio Shack stores, with a new blue and green cover and a photo of author. The book is $11.95, and is published by Master Publishing, Inc. Or circle Reader Service No. 204.

Communication Technology Update, 4th Edition.

Despite the possibly daunting title, this is a book that every red-blooded (and blue-blooded, and even lily-livered) ham should read. No equations. No complex circuits. No build-it-yourself projects. This book is packed solid with the latest hot scoop on what's doing in radio, TV, video, digital, and so on technology. It's all in relatively plain English, except for the welter of acronyms.

So what's MPEG2+? The next time this comes up during a QSO, you'll know the answer. What ever happened to MD and DCC, which your Uncle Wayne predicted in his *CD Review* editorials would fail as new music formats? Sony and Philips wasted hundreds of millions on these. Read all about it.

This 428-page 8" x 11" book is an interesting read, covering digital video compression, cable TV, Video Dialtone, interactive TV, direct broadcasting satellites, high definition TV, low power TV, radio broadcasting, computer technology, the Internet, electronic messaging, on-line services, multimedia, video games, desktop publishing, fax machines, virtual reality, desktop video production, camcorders, digital audio, satellites, distance learning, local and long distance telephones, fiber optics, integrated services digital network, cellular telephones, videoconferencing, and videophones. Nope, it doesn't mention amateur radio, forsooth.

By the time you're through reading this you'll have a good solid general education is current communications technology. Also, if you have even a shred of creativity left after semi-surviving our fabled American school system, you'll see endless opportunities for applying these new technologies to amateur radio. How many QSOs could we cram onto the 20m phone band using compressed digital audio signals instead of SSB? A hundred times as many? With less QRM? If they can cram a VHS-quality video signal on a telephone wire, we ought to be able to put one on 20m. Who will be the first to transmit "Steamboat Willy"2 on 20m?

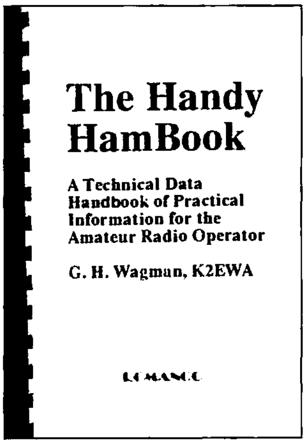
Each of the chapters I listed above were written by experts in their fields. And, despite the Ph.D.s on many of their names, they've managed to make their material easily understandable.

About the only negative is the lack of an index. Tsk!

Oh yes, how much? $37. ISBN: 0-240-80238-1. Focal Press. Buy it. Circle Reader Service No. 205.

Handy HamBook

This is a great little book, packed full of tables, charts, and data you need around the ham shack. Coax info, country lists, antenna formulas, Q-signals, PL-tones, ASCII characters, over 200 pages of essential information that you don't want to have to hunt for when you need it. It's been gathered by Gerald Wagman K2EWA. It's published by *Romanco Enterprises, Box 34, Milltown NJ 08850.* The book is $14.50 postpaid, unless you're in NJ, in which case there's 72c tax. Or, better yet, move to NH and save the 72¢. Circle Reader Service No. 206.



Kantronics

Version 6.0 of Kantronics KPC-3 is now GPS-compatible. The TNC connects to GPS receivers with NMEA-0183 interfaces and make it so users can use as many as four GPS unit's NMEA data strings; GPS data can be stored for later retrieval and is accessible via the KPC-3's mailbox; users can specify beacon start time and amount of time between beacons, so multiple stations can report without a collision; the system operator can reconfigure the GPS unit from a remote location; and it's APRS compatible. Kantronics has an EPROM upgrade available for earlier versions.

Contact: *Kantronics, 1202 E 23rd Street, Lawrence KS 66046 (Fax 913-842-2021) for more information.* Or circle Reader Service No. 207.

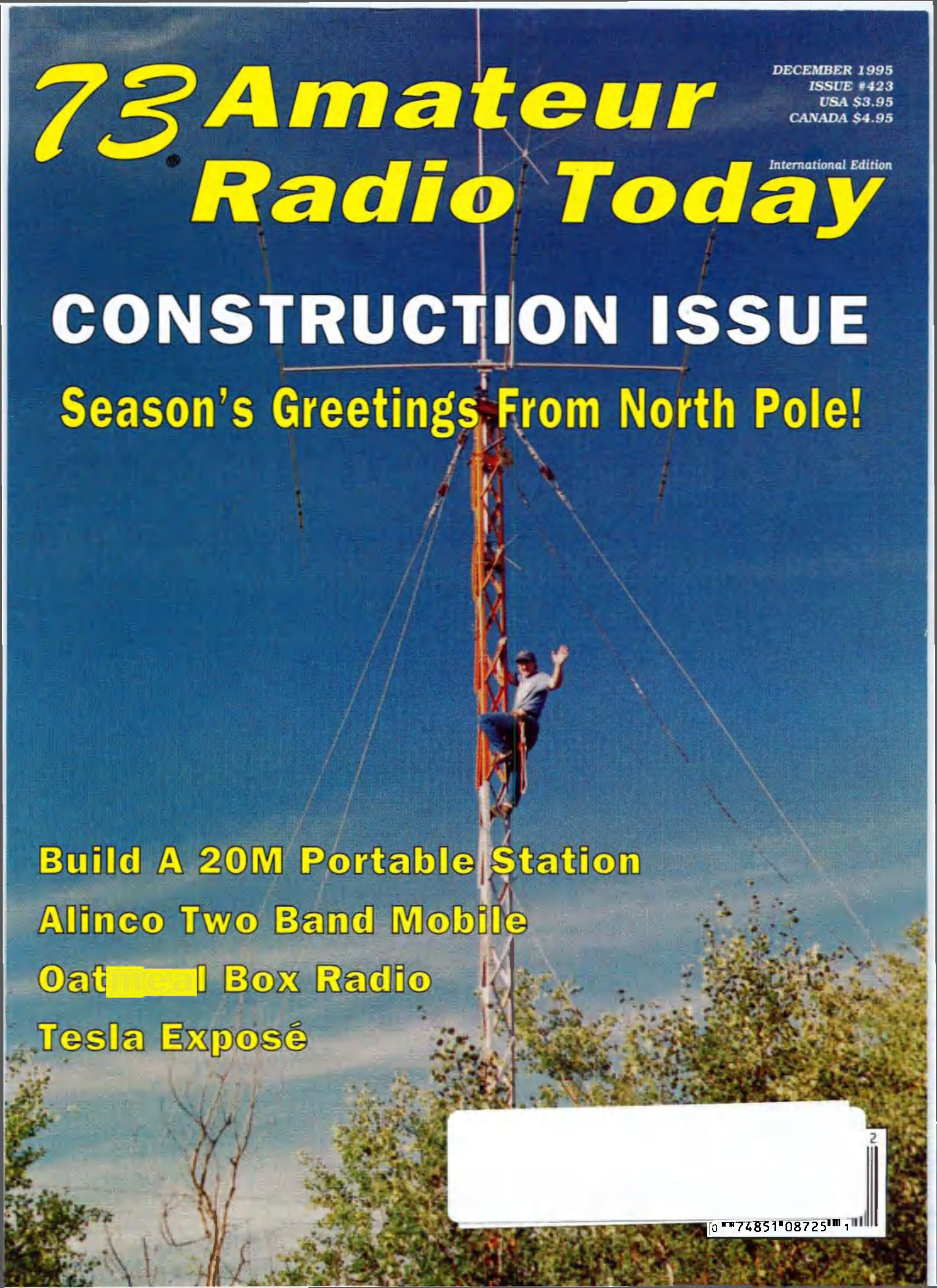
73 Amateur Radio Today

DECEMBER 1995
ISSUE #423
USA $3.95
CANADA $4.95

International Edition

CONSTRUCTION ISSUE

Season's Greetings From North Pole!



Build A 20M Portable Station

Alinco Two Band Mobile

Oatmeal Box Radio

Tesla Exposé

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM or Mac formats), carefully checked drawings and schematics, and the clearest, best focussed and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

DECEMBER 1995
ISSUE #423

73® Amateur Radio Today

TABLE OF CONTENTS

FEATURES

REVIEWS

DEPARTMENTS

On the cover: Season's Greetings From North Pole
This month's cover photo comes from George Pataki WB2AQC, 84–47 Kendrick Place, Jamaica NY 11432. George visited 90 amateur radio operators in 15 localities, and took 640 photographs during his summer, 1994 tour of Alaska. Our cover photo from the town of North Pole, Alaska, features Joel WL7AI sending us Season's Greetings from his very tall and well-anchored tower sporting a three element Yagi and his repeater antenna. Also in North Pole, George met Eric KL7AJ and his 16 year old son David WL7NK and the family of Ed KL7XD, his wife, Sandy WL7PO, their daughter, Danielle WL7QW, and their two sons, Bill KL7TC and Mike, KL7YY who send their Season's Greetings as well.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = greall, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is the page number on which the article or column starts as shown in the index.

73 Amateur Radio Today (ISSN 1052-2522) is published monthly by 73 Magazine, 70 N202, Peterborough NH 03458-1107. The entire contents ©1995 by 73 Magazine. No part of this publication may be reproduced without written permission of the publisher, which is not all that difficult to get. The subscription rate is: one year $24.97, two years $39.97; Canada: one year $34.21, two years $57.75, including postage and 7% GST. Foreign postage: $19 surface, $42 airmail additional per year, payable in US funds on a US bank. Second class postage is paid at Peterborough, NH, and at additional mailing offices. Canadian second class mail registration #178101. Canadian GST registration #125393314. Microfilm edition: University Microfilm, Ann Arbor MI 48106. POSTMASTER: Send address changes to *73 Amateir Radio Today*, 70 N202, Peterborough NH 03458-1107.

Contract: The mere possession of this magazine constitutes an iron-clad legally binding contract between you and Kindly Old Wayne Green, the Publisher, wherein you agree to scour your newspapers and other magazines for items which you think, from reading his lengthy editorials, will interest said publisher. Furthermore, you agree to either send him the clippings or reasonably legible copies. And it wouldn't hurt you one little bit to keep copies of said clippings near your station mike to help you find better things to talk about than your rig or antenna.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Builder's Alert!

If you're not into designing and building little electronic gadgets, skip this, it's not for you.

It all started when an envelope arrived with a little bag of hardware in it. Oh, I'd seen the Sescom ads, but I hadn't really understood how neat their equipment boxes were. I spent a lot of years at the workbench making all kinds of electronic stuff, but nothing as cute as these had ever been available. Considering the size parts used to be, nothing I could have made back then would have fitted into most of these boxes.

So I contacted Sescom to see if they might be interested in me helping them get the boxes better known. Not being crazy, they agreed. Here's the deal. For any article I publish that uses one of their boxes they'll send a $50 check to the author, and that's in addition to the pittance I shell out for good construction projects. A little bonus. Well, since their boxes only cost from $2 to $6, that's a good gamble for any builder.

Don't go away, I'm not done.

Sescom also makes some remarkably inexpensive modules for various audio applications. SIPs. These are also cute little buggers. If you can figure out some hamshack applications for these and come up with an article I can't refuse, Sescom is offering a $100 reward, plus whatever you can squeeze out of Never Spend a Dollar.

There are 23 varieties so far, ranging from $15 to $35; things like mike pre-amps, remote volume control, automatic level controls, etc. These miniature circuit boards aren't much larger than ICs.

I'm still not done.

Sescom makes most of their SIPs in fairly short runs, so they don't need to have a market for tens of thousands to be interested in making more SIPs available. What they need is for you to brainstorm a small circuit and send them a prototype. If they like what you've done they'll swing into action and add it to their catalog, with you getting $100 up front for the idea, plus a royalty on every sale. And I would expect, at the very least, an article from you on your handywork. With good photos.

If your brain is all fogged up due to your poisoning yourself with mercury (fillings), Big Macs, Nutrasweet, Bud Light, and so on, then you can substitute some research into ham rag back issues for the creativity you'd otherwise have.

Sescom is mostly into audio circuits, but with your help maybe we can get them to start making some RF modules. Maybe some digital too. I'd love to have a module that would send my call digitally every time I push the mike button. At 9600 baud it would zip by like that. Then I'd want another module to decipher the signal when it's used by others. The next thing you know we'd start seeing some of the big companies building this into their rigs, with a little LCD readout on the receiver giving the call of the station you're receiving.

What else do you need?

How long will it be before we have a module in our rigs that we can load a digitized picture of ourselves into? That takes me back to the early slow-scan days around 1970, when I had three cameras set up in my shack, with one aimed at a menu board, a second at a slide projector, and the third at me. And there was this guy in Caracas who used to send hours and hours of Playboy centerfolds.

And the time when I went to Navassa to operate as KC4DX and took along some slow-scan QSOs on audio tape, plus a recorder to see what I'd received after I got home. I remember calling in on the slow scan channel on 20m and being told to go away because there was (wow!) a Mexican station on there that everyone wanted to contact. So I moved up the band and gave a few of the more alert slow-scanners a new country, while the herd were working that Mexican SSTV station.

Get out your soldering pencil and let's see what you can do to have some fun and maybe even get Sescom better known.

Reminder For Skiers

Snow permitting, am I going to see you at Aspen January 4–11th, HT in hand so we can talk while on the lifts? That's the low season at Aspen, when prices are reasonable and the lift lines minimal (or less). And think of the fun we'll have solving amateur radio's problems over some delicious dinners. Mmm. We've had mini-hamfests at Aspen for many years and had a ball. Skiing is half price if you're over 65, and free at 70. There probably are some better places in the world to ski, I just haven't found them yet. Let me know via fax: 603-588-3205 or via ProFusion@AOL.com.

Cuban QSLs

A letter from Thomas Hark KB8TAG enclosed a note he'd gotten from Oscar CO2OJ, explaining about his problem getting QSL cards, even though they've been sent to his post office box in Cuba. Oscar has been busy this last summer working American grid squares on both 2m and 6m via tropo and sporadic-E, hoping to be able to get the VOCC award. But with 75–80% of the QSL cards not making it through the Cuban postal system, he's not getting the needed confirmations. A big part of the problem may be the $1 and $5 Green Stamps enclosed as incentives for a fast response. I suspect Oscar could get 100% of his wanted cards if he lined up an American QSL manager.

DXers can do well with Green Stamps if they can actually get their mail. I remember talking with Don Miller W9WNV back in the 1960s when he was going around the world DXpeditioning. He claimed that he was making over $50,000 a year charging for QSLs, with no income tax, since there was no way for the IRS to find out about it. And that would be more like $500,000 in todays dollarettes. Say, does anyone know if Don's out of prison yet?

Too bad if you missed the fun last summer on six meters. Many days it was hotter'n a pistol. With the sun spots cranking up, how about getting set up to have some DXing fun on 6m next summer?

Wayne Wrong On EMFs!

Well, that's what a lot of readers have been saying, putting me down as just another hysterical eco-nut. After all, they've been saying, if there was any real problem the Health Department or the EPA would have acted long ago. Sure, like they've whipped into action in the case of cigarettes, which are a long-proven cause of sickness and death. Heck, cigarettes kill more Americans every year than AIDS, drugs, automobile accidents, and murders combined. But is that enough to warrant action? Not when the tobacco

Continued on page 74

LETTERS

From the Ham Shack

Mike Carbaugh WA3HDQ First a little background info. I've had my ticket since 10th grade in 1967. I worked a lot of 6 meter AM and 2m FM, back when 2m was fun. Seems like now-a-days each repeater has its own little "group." But I still use an HT in the car. I commute 52 miles one way and it's nice to have.

I faded away from Ham Radio back in the late 70s. Since Techs were given 10m, I got back on the air in 1992. I run a barefoot-no frills station consisting of (1) Kenwood 520SE and Realistic HTX 100, mobile 10m; (2) 10m vertical; (3) HQ Mini-Quad, 6, 10, 15, 20 meters. (4) Coaxial dipole for 40m. Thanks to *Radio Fun*for info on construction. (5) Just purchased a PK-88 TNC; (6) searching for PC or Dumb Terminal. (7) Joined AMSAT and listen to the "birds." (8) Realistic HTX 200 m HT.

Some random thoughts for newer ham and others. (1) 2m/10m crosslink repeaters are a lot of fun. Try them out if any are in your area. (2) send an SASE or postage when QSLing. (3) Clubs do more for newer or lower grade licensed hams - let them do some operating at field days, during contests and special events. Loosen up the meetings, don't hold every one strictly to business. (4) Don't be so quick to point out a newcomer to the repeater made a mistake and said "Break." (5) Look what Techs and Novice did to activity on 10m! Allotment of more privileges on HF bands could increase our amateur ranks. (6) My last 125 10m contacts: 63 were Tech or Novice; 20 General class; 24 Advance class; 18 Extra class. (7) Seems to me everyone is taking advantage of Tech Plus and Novice activity on 10m. (8) What could we bring to other HF bands? 15 meters?

One final thought: I agree with you and so do many other silent hams - to "Hell with the Code." It's holding many good potential ham back.

Steven Katz WB2WIK/6. Your October editorial in 12 re "Money Ideas," etc., brought to mind something that many hams know about and very few capitalize on. Many hams, including you and me, are PC nuts who have been there since the beginning. I had a "Sol" in 1976, followed by my first "real" PC, an Apple II, in 1978. First DOS system (IBM-PC) in 1983. Lacking available software in the early days, I wrote a lot of BASIC programs myself, as I'm sure you did. I now work in the PC peripherals industry and my office is in a building originally built and occupied by Pertec, the first real hard disk drive manufacturer in the U.S. They became part of DDC and then finally folded some years back, but Pertec launched a lot of businesses, including Micropolis (also here in Chatsworth, CA), Tandon and others. I feel like a dinosaur in this industry that is only maybe 18 years old. Sigh.

The business opportunities in PC peripherals are abundant. With read-write optical media and mechanisms becoming so affordable, floppy disks will soon be a thing of the past. Hard disks are already at 9 Gb and Micropolis (and probably others) are developing 18-19 Gb drives right now. RAID systems (Redundant Arrays of Independent Disks) for fault-tolerant data storage are becoming so popular that "hackers" already have them, including systems capable of storing 63 Gb of data in fail-safe setups that can't lose a single Byte of data even in a disk "crash." Pinnacle Micro and others are introducing 4.6 Gb optical read-write mechanisms with very affordable media. Where will it end? Nobody can possibly predict, but there's surely no end in sight.

My 4-1/2 year-old daughter knows how to operate Windows 95. The information superhighway is alive and well, and anyone who isn't on the Net is almost passé. I think the latest figures indicate some 35 million users on the World Wide Web, and this is bound to double in the next year or two. Highly competent PCs for less than pocket change abound in the marketplace. How can hams cash in on this? It's obvious. Networking and performing value-added retail services. The whole industry is so simple to understand that it's populated mostly by folks who barely graduated high school. CD-ROMs are almost a thing of the past, since recordable CD mechanisms have become both available and affordable. Pinnacle's new Apex 4.6 Gb drive is priced within reach of anyone who can buy lunch, and as prices continue to drop there will be no reason the average hacker can't afford a 14-disk array jukebox for home entertainment. But end users are so silly they will continue to need integrators who are added-value resellers. And many folks would like to be part of the Web, but have no idea how to get on.

This is a fantastic business opportunity for thousands of hams who have any inkling whatever about how to set up a PC with a modem and get on line with an Internet provider. It's child's play, and as amazing as it sounds, thousands of slightly technically-inclined individuals are making a great deal of money being part of the Superhighway. Mind you, these are short-term opportunities. Technology progresses faster than most of us can keep up, and many might have to be satisfied making their first million in the next year or two and then retire to operating from Tahiti.

It's progressing faster than most could possibly imagine or keep up. But the money is available and there for the taking for enterprising folks who don't mind working. It doesn't take any financial investment, only the time to study and keep abreast of the rapidly changing technology. Banks, insurance companies, law firms et al, all need fault-tolerant data storage. How many hams are in this field? Raise your hands. Pity. Not very many. Tsk.

It's no good Steve, 20 years ago I tried hard to get hams to take advantage of the exploding computer field. The industry grew at 235% a year for its first seven years, just as I'd predicted. Thousands of people made millions. Some made billions. But you're right, the industry is still growing fast and shows no sign of slowing down, so there's plenty of money out there for manufacturers, programmers, consultants, and service providers. Any ham could live in a dream ham location and have a dream ham station, if he wanted to. All it takes is some self-education in computers and the gumption to do it. It doesn't take a lot of brains to be a computer Ph.D., just some work. Wayne.

Michael Forinash KBØRIA. Wayne, I've only been reading *73* for two years, but I think you're doing a fine job. No complaints. Suggestions? Why not run an occasional photo of vintage equipment on the cover? I missed out on the 20s, 30s, and 40s, but I love looking at equipment from those periods. And how about more QRP projects?

Anyone got a good photo of a mint SW-3 or a Skyrider Diversity we can run on the cover? Wayne.

Sid Choudhry KK6RN. I noticed in the September cover picture of your shack that you have a Palomar PT2500 antenna tuner just like mine. I've been looking everywhere for a manual for this tuner. Even Palomar hasn't been able to find one. I wonder if you have one you could copy for me? *Nope, mine's long gone, but I'll bet one of our readers can help. Sid's at 2487 Cliff Road, Upland, CA 91784. Wayne.*

Frank Rumph KD4DZI. Wayne, a while back you asked hams to be courteous. A lot of them are nasty to each other on the air and the newspapers are telling us that violence has increased alarmingly among our youth since 1983. This was when Nutrasweet was introduced. Coincidence? Aspertame has been called a mind-altering drug and I've seen its effect on my wife after eating just one package of diet Jello pudding. Coincidence? I just use Ivory soap to wash my hair and my sense of smell is working fine. We had a policeman come to our ham club to talk about crime. He said if you use Mace on a person who has taken drugs it makes them more violent.

Nutrasweet (aspartame) looks to me like proof positive that money buys the FDA, just like it does our congress. Endless reports of it's side effects show it can be devestating. Perhaps we should ask that any ham who has downed a diet cola or soda not operate for 24 hours. That might even clean up 14,313. But would it keep K1MAN off the air? Wayne.

Kintzonidis Sriros SV2BXC We had a tremendous 2m band opening on June 2nd. I was running 50 watts and got a 59 from F5NZO and then again from F5IRS, a path of about 2280 km! Then I worked F1CCB, HB9JAW, HB9RSO, and HB9SNR, all on 144.250 using FM. The sporadic-E was so strong I could hear HTs and it lasted for about an hour

Continued on page 82

QRX . . .

New 2m DX Record!

Tropospheric ducting resulted in some great DX for the alert, with the path opening between Hawaii and the West Coast at the end of June. Too bad if you missed it. The best DX was between Paul Lieb KH6HME, operating atop Mona Loa (13,680 feet) on the main island, and Jim Costello W7FI in Woodinviile, Washington, up near Seattle. That's a distance of 2,692 miles. That was just a tad further than Pau's contact five years ago with XE2GXQ, on Baja California. Paul also worked WI7Z and N7KSI in Washington, and N7AVK in Oregon. VE7SKA heard Paul, but couldn't get through. Anyone want to bet that SKA won't have a bigger signal next year? KH6HME also made 432 contacts with K6QXY and W6SYA, but 2m was the hot band.

Launch contract for phase 3-D finalized

The Amateur Radio Satellite Corporation (AMSAT) has announced plans to launch the Phase 3-D satellite aboard the second flight of ESA's new Ariane 5 (Ariane 502) for approximately $1M US. The launch is currently slated for September, 1996, but if not possible could be shifted to an older Ariane 4 booster for launch by mid-1997.

Repeater Coordinators Meet

The nation's repeater frequency coordinators recently met with the ARRL and the FCC in St. Charles, Missouri. It was a politically charged meeting that has changed the face of VHF operation forever. This is because there is now a tentative agreement by which the American Radio Relay League has tentatively agreed, subject to board approval, to represent the nation's coordinators to the FCC. This, in exchange for the commission recognizing the work of the coordinators and possibly making their decisions binding on the ham radio community.

The meeting was held at the Best Western Noah's Ark motor hotel not far from the St. Louis Airport. About fifty of the nations sixty five recognized repeater coordinators were present. Also in the room were representatives of packet radio, amateur television and other modes that use the VHF and UHF spectrum, but from the outset it was made clear that this meeting was to discuss the problems of FM voice repeater coordination only.

Even though he was there unofficially, the tone of the meeting was set by the keynote speaker Ralph Haller, N4RH, Deputy Chief of the FCC's Wireless Telecommunications Bureau: "I'm particularly delighted that all of you have taken time from your schedules to be here and you have shown so much interest in this matter, that you would come to St. Louis on a Saturday.

I would like to ask that we try to stay focused. In talking to you, I know a number of you in this room have lots of other concerns. Enforcement, changes in the volunteer examine program, but that is not what today's meeting is about. Today's meeting is to talk about frequency coordination. An opportunity to get to really get to know each other. And it's an opportunity to bring frequency coordination to yet a higher plateau. So during the day let's stay focused on the real issue of why we are here. Let's not get side tracked on other issues that can easily take up the day. Let's stay focused on frequency coordination. This is a truly historic day in the history of Amateur Radio." Haller, N4HY

Historic yes, but not without its problems. For a while, the entire proceeding seemed to be slipping away as the political differences between various coordinators and between some coordinators and the ARRL took center stage. As a result, much of the early discussion derailed into matters of finite detail rather than the general picture that Haller had requested. So, not unlike other legislative bodies in a state of conflict, the group recessed. It was when the meeting reconvened that headway began. Owen Wormser, K6LEW, the president of the Mid Atlantic Repeater Council was the person who brought it back on track:

"For the sake of a beginning can we agree that those that are listed in the current ARRL Repeater Directory as coordinators for their specific areas etc. are in fact the baseline from which we can begin. Perhaps, but not the final solution, perhaps not the end of it, but can we agree that that is at least the beginning. Because where the next point goes is, if that is agreed then we have something else to say. And that is that in the longer term our objective is to produce the white paper which will be the assemblage its direction, it was Jim Fortney that added purpose:

"It has become very clear to me and I hope it would be clear to the majority of the rest of you, that the environment that the FCC finds itself in no longer allows us to use the methods and techniques that we have used in the past to deal with them. And that in fact that we better look at some new approaches. And one of those approaches that is being used elsewhere and has been suggested from a variety of directions that would be advantageous to us is if we, and I am talking about amateur radio, not repeater coordination necessarily, but amateur radio in total, we amateur radio had someone who represented us to the FCC." Fortney

Discussions and debates lasted another four hours. In the end it was decided to name the American Radio Relay League as the single point of contact, or spoc, between the nations frequency coordinators and the FCC. A committee chaired by Owen Wormser, K6LEW was empowered to draft a white paper setting forth the goals of the spoc. This paper will be circulated to all the nations recognized frequency coordinators listed in the ARRL repeater directory for comment before a final version is submitted. All of this seemed to please the FCC's Haller:

"Clearly this afternoon, I think tremendous progress has been made. And I look forward to continuing to work with this group and your representatives who will ultimately be working with us directly in Washington. I think this is a giant move forward for Amateur Radio and I think it says a lot that all of you come here with such diverse views and in the course of a few short hours reach this kind of consensus." Haller

There is still a lot to be done before recognition of the work of coordinators becomes reality. Two of the biggest hurdles are drafting a white paper acceptable to most coordinators and for the ARRL's Board of Directors to vote on whether or not it really wants the SPOC job. The latter will happen in mid January.

But assuming both of these tasks are accomplished, it may eventually mean that the average ham, people like you and me who simply operate FM with a mobile rig or an HT can be assured that the day of the so-called pirate repeater will come to an end. That our ability to communicate through our favorite repeater with a minimum of interference from another uncoordinated and unwanted repeater on the same channel pair, will be assured. And from a users point of view, what more can an FM enthusiast want.

FCC Closing Several Offices

The recent Republican economy drive has hit the FCC, which has never been generously funded. The result is the announced closing of their Regional Offices in Atlanta, Boston, and Seattle. The Field Offices in Anchorage, Houston, Portland, Buffalo, Miami, San Juan, Honolulu, Norfolk, and St. Paul will also be closed, as will eight of their monitoring stations. The most serious of those is the Norfolk Office, which was the training center for FCC agents for the whole country. No more "pink tickets" from Grand Island!

This presents an opportunity for amateur radio to offer to provide a new service for the FCC. We have thousands of handicapped and retired hams who would gladly volunteer to help monitor the spectrum as a public service. Since hams are everywhere, they could provide a more thorough monitoring service on LF, HF, VHF, and UHF than the FCC has had.

ARRL Seeks Enforcement Action

The ARRL may be headed to congress to try and force the FCC to enforce the Amateur Service rules. At least the rules that govern willful and malicious interference.

According to Minute number 3.1 of the recent Executive Committee meeting, on a motion presented by Director Joel Harrison, WB5IGF, League President Rod Stafford, KB6ZV has been directed to appoint an ad hoc committee to—and we quote: "develop objectives and strategies to achieve legislative solutions to the problem of inadequate enforcement."

This action was prompted at least in part by a report to the committee by League General Counsel Christopher D, Imlay, N3AKD. In his report, Imlay reported that progress on two egregious cases of repeater jamming have proceeded far

slower than had been promised by the FCC staff. N3AKD also noted that the announced closings of FCC field offices along with staff cuts appear to have contributed to a deterioration in morale.

The FCC's internal problems not withstanding, the ARRL appears to have concluded that the commission has a constitutionally mandated responsibility to the American public. And since radio amateurs are a part of this constituency, the FCC has an obligation to enforce the rules it makes. If the agency fails to do so, then legislative action may have to be taken to make it happen.

Also noted in the committee minutes is RM-8626, a petition by W5YI Report publisher Fred Maia of Arlington, Texas. Minute 3.6 says that the petition which would outlaw most one-way high frequency transmissions was strongly opposed by hundreds of commenters and should be, dismissed

Imax Images Of Shuttle-Mir Available Via Internet

Hams with Internet access will find several dramatic new images highlighting the historic docking of the Space Shuttle Atlantis and the Mir space station are available on the World Wide Web. The high resolution images show crew activities and views of Atlantis taken from Mir recorded using a 70-mm IMAX camera.

Links to the collection can be found on the "Today at NASA Home Page" on the World Wide Web.

ARRL Honors NY Heros

The American Radio Relay League has given its highest possible honor to a New York area radio amateur. At its September 16th Executive Committee meeting in Albuquerque, New Mexico, the committee voted unanimously to present its National Certificate of Merit to Henry Borawski, KB2PFP. This for—and we quote—"the bravery of his actions in responding to the World Trade Center bombing."

According to ARRL Hudson Division Director Steve Mendelsohn, WA2DHF, Borawski used Amateur Radio to assist citizens trapped inside the World Trade Center after the bomb went off. Mendelsohn who sponsored the Borawski nomination says that the award was given in recognition of the professional manner in which KB2PFP performed his acts of heroism.

At the same meeting, the Executive Committee also took note of the heroic efforts of numerous Long Island, New York hams who donated their communication skills is assisting firefighters beat back a six thousand acre blaze. The committee singled out three hams, Section Manager Rick Ramhap, N2GQR, Section Emergency Coordinator Mario Maltese, WF2T and Suffolk County District Emergency Coordinator Andrew Feldman, WB2FXN, for special praise.

Fluke Oops!

If you have a Fluke Series II DMM, Model 21, 23, Kit-23, 70, 73, 75, or 77, Fluke wants to get it back to be modified. It seems that anything over 400 V, ac or dc, may indicate zero volts, which could lead one to get one heck of a surprise, if the reading is believed.

Israel Callbook

Shlomo Musali 4X6LM is preparing a callbook of Israeli hams activer on the Internet. Send internet addresses to: mussali@shani.net. You can get the Israeli Callbook on the 'net at: http://ww.qrz.com/cgi-bin/webcall.

From The Internet.Amateur Radio Newsline

Amateur Radio at the Technoda

The Technoda, a technical museum in Haifa, Isreal, is planning a full operational HF station with a 3 element Yagi antenna, a display of CW reception as well as satellite communication and packet radio.

ARRL Phone Change

The ARRL has new phone numbers as the result of an area code for Newington. The Prefix has changed to 860 but the previous area code, 203, will continue to work until September 1996.

DX

In DX, EI4BZ informs us that he hopes to go mobile and activate some squares each Tuesday evening on 80 meters from 19:00 UTC. He adds that other mobiles are welcome to join in for a contact. QSL as directed.

And interest in the Worked All Ireland Award continues to grow. Quite a few amateurs are now operational on or around 3.670 MHz from 19:00 UTC time most evenings. If you are in the shack, do give a call on 3.670 as recent activity has seen up to twenty operators on the net. 73

A Portable Integrated 20 Meter SSB/CW QRP Ham Radio Station

A ten pound powerhouse!

J. Frank Brumbaugh KB4ZGC

How would you like to put together a neat single package 20 meter ham station capable of being powered by either the normal 120-V commercial power or a 12-V battery? It occupies a volume of less than one quarter of a cubic foot, and its footprint is just a bit more than one quarter of a square foot. It weighs less than ten pounds, and a handle on top makes it easy to carry anywhere on trips, for Field Day, emergency operation during a local disaster, or nestled in the corner of any room at home.

This integrated ham station consists of four modules, stacked atop each other, and held together with aluminum straps. In order, from bottom to top, are the power supply and speaker module; antenna tuner (MFJ-971); transceiver (MFJ-9420 with microphone); an accessory module, topped by a carrying handle. All interconnecting DC, AF, and RF cabling is in the rear.

The station is capable of producing up to 8 watts CW and 10 watts SSB, and covers the entire 20 meter band in two switched segments. It contains a CW filter with four selectable bandwidths between 750 and 100 Hertz, with no ringing. The center (peak) frequency of the filter is adjustable between 400 and 1,000 hertz, an important plus for those who do not like the usual 750 hertz center frequency. A crystal-controlled marker generator with a 25-kHz output marks the subband edges and maintains calibration of the analog dial. It is controlled from the front panel. An electronic keyer is included, switched on with the filter from the front panel.

It contains a 20-watt 50-ohm dummy load, and a panel mounted RF wattmeter is included. RF from the transceiver can be switched from the input to the antenna tuner, a resonant antenna, or to the dummy load, with a front panel toggle switch. RF power is constantly monitored on this wattmeter. A 1-watt front-firing speaker is included in the power supply, along with both 3.5-mm and 1/4-inch headphone jacks which cut off the speaker when phones are being used. The "icing on the cake" is a 24-hour UTC LCD clock with its own internal battery.

Power Supply and Speaker Module

The power supply uses a standard linear regulator circuit. The transformer has a 16.3-V, 3-A secondary. A 10-ampere bridge is used with a 20,000-µF filter capacitor. Regulation is provided by an LM317T and a single 2N3055 NPN power transistor mounted in a 3"x 4" x 1" flanged heat sink, slightly narrowed with a hacksaw to fit on the rear deck of the Ten-Tec TP-45 aluminum clamshell enclosure. This enclosure is the exact same width as the MFJ cabinets, slightly less in depth and a fraction of an inch higher. A 1-watt, 8-ohm speaker with a large magnet is mounted on the panel, below which are a 3.5-mm and 1/4-inch phone jacks. Also on the panel is a meter which monitors either the DC voltage or current. The meter circuit includes a home-brew 3-ampere shunt, and a zener diode suppresses the meter zero, so the meter indications are from 10 to 15 VDC, and 0-3 amperes. There are two RCA jacks on the rear deck, providing the power for the remaining modules. One of these jacks is a spare and the other allows a 12-volt battery to be plugged in to supply power when commercial power is unavailable.

Antenna Tuner

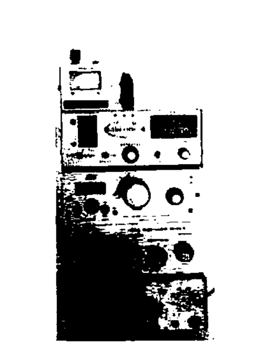
Although I used an MFJ-971 Portable Antenna Tuner with a twin needle meter to indicate SWR and forward and reflected power, any antenna tuner capable of matching your antenna to the 50-Ohm nominal output of the transceiver can be used. I used a Ten-Tec TP-45 enclosure. (The MFJ-971 tuner is available from AES for $84.)

Transceiver

I used the MFJ-942OX (including the microphone, it was $210 from AES) because it is much more flexible than the other QRP rigs currently available. It's a very well engineered transceiver, originally intended for SSB, but a CW adapter is available which makes it a very fine rig indeed. The receiver is both extremely quiet as well as sensitive. This is a very popular rig. I bought one of the first ones from AES, and it was on back-order for three months. In this circuit the audio output must not be grounded, so you can't mount an external speaker jack on the metal rear deck. A simple modification is to insert a pair of back-to-back 8-ohm to 1,000-ohm tiny Radio Shack audio transformers between the output of the U5 chip and the speaker. One lead of the speaker and of the 8-ohm output winding of the audio transformer can be grounded, with the other lead of the transformer and speaker going to a closed circuit jack which can be mounted at the upper right hand corner of the rear deck (with the front panel facing you). The two transformers can be epoxied to the left side of the chassis at the top, near the rear deck.

Accessory Module

I used another Ten-Tec TP-45 enclosure for the accessories. It contains the RF Wattmeter and switching circuitry, and the dummy load. The dummy load consists of parallel-connected 470- and 560-ohm, 2-watt, 2% metal film resistors, five of each, sandwiched between two pieces of single-sided PC board stock, bolted to the inside of the rear deck. A SPST NO relay, controlled by a toggle switch on the panel, switches the RF from the transceiver to either the RF OUT SO-239 (to



Front view of the Portable Integrated 20m SSB/CW 2RP Station.

tuner or antenna) or the dummy load. The RF voltage sensing and rectifying components are mounted directly on the RF IN SO-239, and the DC voltage equivalent to the RF power in watts is routed to the panel meter through its calibration multiplier trimpot. A red LED, in series with the 2.7K-resistor, indicates when RF is routed to the dummy load. The LED draws about 4.5 mA, yet is quite bright.

Crystal Marker Generator

Probably most of you have a crystal marker generator, as I do. However, I constructed one specifically for this station on a Radio Shack 276-150 general purpose PC board. The oscillator is a 74LS00 with a surplus 5 MHz crystal, divided by five in a 74LS90 to 1 MHz, then by ten in another 74LS90 to 100 kHz. This is divided by four, to 25 kHz, in a 74LS74, and an insulated wire from pin 5 is wound one turn around the insulated wire between the RF switching relay, mentioned above, and the dummy load. It is preferable when using the crystal marker to switch to the dummy load so the only signals you will hear will be at 25 kHz intervals. A green LED is controlled by the generator's on-off switch.

Electronic Keyer

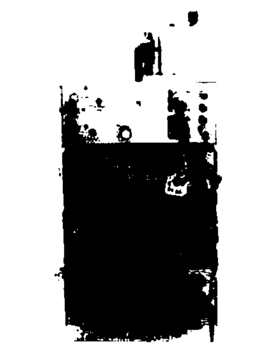
Most of you who are using CW have and use electronic keyers, and any keyer can be used. The one I use is a "poor man's keyer," designed by AB4DP in 1989. It does what it is supposed to do, and at very low cost. Built on a Radio Shack 276-150 PC board, it contains six TTL chips of the LS family to hold current down, and a 5-volt regulator. The speed control pot is mounted on the rear deck because it will seldom need adjusting. It is turned on and off by the same panel switch as the AF Filter, with a yellow LED indicator.

CW Filter

Although I much prefer to copy a low (400 to 500 Hz) CW note, I was almost ready to install a 750-Hz filter I had constructed using one of W1FB's designs when I glanced at a new Ramsey Electronics catalog. Their new Model AF-1 filter uses a pair of MR8 switched capacitor filter chips, incorporates an LM380 amplifier to bring up those weak CW signals from the noise, has four selectable bandwidths (750, 500, 250, and 100 Hz) plus an adjustable center (peak) frequency. I would not have to listen to 750-Hz tones; I could pick my own lower frequency note. The cost, in kit form, is $36 plus the usual S&H. This filter also contains a limiter circuit at the input so it cannot be overloaded with too high a signal from the speaker jack. Because Ramsey intends this filter to be a self-contained item, it uses a bridge circuit so it can be operated from 12 VAC or 12 VDC without regard to polarity. It also contains board-mounted RCA jacks for audio input and output. Three DPDT push button switches, also board-mounted, provide on/off power and filter bypass on one switch. The other two switches must be manipulated in a relatively complex in/out system to select the desired bandpass. The CW gain pot is board-mounted. So is the pot which adjusts the center peak frequency. Because I intended to install this filter in the accessory module and use 3.5-mm phone jacks for audio in and out on the rear panel, and also because room in the accessory module was rapidly diminishing, I mounted the keyer where the filter would have to fit. I took my trusty hacksaw and removed the rear section of the PC board, eliminating the power bridge and RCA jacks. Also, I have an aversion to board-mounted controls, so I did not use those supplied. I used a DPDT toggle switch to control power and to bypass the filter, and two sections of a 4-position wafer switch to select the four bandwidths. I mounted a standard 10k pot on the panel for CW gain, and installed a rectangular multiturn trimpot replacing the pot which selects the center peak frequency, which I set for 500 Hertz.

Operation

Although my antenna, 33 feet of sloping wire at an average height of ten feet, is hardly state of the art, it's the best I can manage in my location, so I didn't have too high a hope for results. Tuned up, I can produce 5 watts CW and 8 watts PEP on SSB. I have tried it on SSB because my average power is probably no more than 3 watts which, combined with a much less than optimum antenna, should be a severe handicap. If I could talk with anyone I would consider myself lucky. The first five QSOs with this new station really surprised me! Even though conditions were very poor,



Rear view of the Portable Integrated 20m SSB/CW 2RP Station.

W3FPN in Florida gave me a 4 by 0. He was 5 by 1-5. The next day PAØEWE, who was only coming through 5 by 1, gave me a 5 by 1-4. We had a 10-minute chat, and he was running 400 watts to a beam. Okay, *he* was doing most of the work. AA2NU (NY), who was only 5/4, gave me a 2/2. W1KY (NY) was 5/8 and gave me a 5/6 and a note on his QSL that mine was the best QRP signal he'd ever heard. How about GDØPLT on the Isle of Man (in a pileup!), he was 5-5 gave me a 5/1-2. He was running 400 watts and a 2-el triband beam. Obviously, much praise should go to MFJ and the engineers who designed the MFJ-9420. The Ramsey AF-1 filter is phenomenal. Listening on CW, I was able to pick out a weak signal down in the noise and gradually hoist it up until it was all alone in the center of the 100 Hz passband, with absolutely no ringing. I wouldn't have believed it until I actually tried it.

What Does It Cost?

Although the main components: MFJ-9420X and MFJ-971 total $294 (from AES). Then, other than the $36 for the AF-1 filter kit, I delved deeply and often into my junk box. Therefore, I spent quite a bit less than if I'd purchased all new or surplus parts. To give you an idea of total cost to duplicate this station I have gone through my catalogs to get the latest prices. The power supply and speaker: $51.25. CW filter: $42. crystal marker: $9. RF wattmeter and dummy load: $16.50. Electronic keyer: $11. Two TP-45 clamshells: $25. Handle: 50¢.

Conclusion

This article was written not for you to duplicate my particular station, but to suggest an approach which you might wish to emulate, using whatever rigs and accessories you have on hand. Look for me on 20 meters from Puerto Rico, both CW and SSB. I may not bend the needle of your S-meter, but I can give you a fine Q5 signal!

Nostalgia For The Future

High performance crystal radio utilizes a high-efficiency JFET detector and dual resonant circuits for superior performance.

by David W. Cripe KC3ZQ

Abstract: This article describes a high-performance crystal radio receiver utilizing a hign-efficiency JFET detector, and a dual-resonator tuned circuit for high selectivity. Included are a parts list, plans, and photographs showing construction details.

Ultimate Crystal Receiver

In our age of satellites, Digital Signal Processing, and packet radio, why would anyone give a second thought to a technology that was obsolete by the vacuum tube? Even though the crystal radio has been with us since the earliest days of the radio hobby, there are still thousands of enthusiasts who have a fascination for the lowly crystal receiver. There are thousands of hams who received their introduction into radio through little, home-brew crystal receivers, and to us, these conglomerations of wire, headphones and cat whiskers hold a special nostalgic attachment.

Having gotten my start in radio some twenty-five years ago with a little crystal set, I never really stopped playing with them, having built perhaps a dozen or so over the years, testing out one idea or another. Recently, I decided to design and build the ultimate crystal receiver. I spent a couple months here and there experimenting with various tuning configurations, and detector circuits, arriving finally at a design capable of pulling in some real DX. I found that with the proper design and a good antenna, a crystal radio is capable of performance equal to that of a typical portable transistorized receiver, and is much more fun to build and operate!

How It Works

Since a crystal radio has no amplification, it is essential that as much as possible of the energy entering the antenna be converted to audio energy in the headphones. Consequently, each of the components of the receiver must operate with very little signal loss. See Figure 1, the schematic of the new-and-improved crystal radio. Unlike the crystal sets that most of us are familiar with, this one uses two coils, L1 and L2, each with its own variable capacitor. The coils and capacitors in a crystal radio form a tunable band-pass filter with which the desired signal can be selected, and the unwanted signals rejected. These two resonant circuits form a two-pole band-pass filter giving much higher selectivity than that attainable with a single circuit. Dual resonant circuits are nothing new in crystal sets; the idea has been around since the days of spark. But, the additional selectivity the technique affords is especially useful in separating signals in today's crowded AM band. Additionally, coil L1 has a sliding tap to match the antenna impedance to the rest of the circuit; similarly coil L2 has a sliding tap to match the impedance of the detector and headphones. Figure 2 is a detailed close-up of the coils.

The purpose of the detector in a crystal radio is to convert the amplitude- modulated radio-frequency signal to an audio signal. It does this by clipping off the negative half-wave of each RF cycle, yielding a signal containing an audio- frequency term. The most radical departure of this receiver from conventional crystal radio design lies in the design of the RF detector. The detection efficiency of the 1N34 germanium crystal diode used as the detector in most crystal receivers diminishes rapidly if the peak amplitude of the RF signal applied to it drops below 0.3 volts. Consequently, in this design, the crystal diode detector has been discarded in favor of a circuit utilizing a Junction-Field-Effect-Transistor having superior detection efficiency and weak-signal performance than that attainable with a diode detector.

The detector used here is comprised of the circuit containing Q1, C3, R1, R2 and B1. The drain of the JFET Q1 is connected to the sliding tap of L2, and the source terminal of Q1 is connected to the headphones. The gate terminal of Q1 is coupled to the 'hot' end of L2 through C3. The drain-source channel of a JFET acts as a variable resistance, controlled by the voltage applied to the transistor gate. Since the 'hot' end of L2 has a much larger RF voltage amplitude than is present on the tap for the drain of Q1, we can take advantage of this voltage gain to cause Q1 to transition cleanly between a high-resistance and low-resistance state. This makes it a very effective RF detector, one requiring no external power source! (Note: You may want to experiment to see just how effective the JFET detector is—temporarily remove the circuit, and replace it with a 1N34 between the L2 slider and the phones. Quite a difference!)

Notice that there is a battery in the circuit—usually forbidden in crystal radios! This battery is NOT used as a power source for amplification, but as a voltage source, which, with resistors R1 and R2, is used for setting the bias voltage on the gate of Q1 for maximum sensitivity. (It is interesting to note that bias voltages were sometimes applied to the crystal detectors of early crystal radios, for the same purpose.) When operating, the current draw from this battery is only 9 µA, so even under daily use, this battery should last for several years. Because of this low current draw, this circuit will work fine using old batteries too weak to run your Walkman.

Building The Radio

Unlike most electronic construction projects, a crystal radio requires one to be a bit of a handyman to put one together. You will need some wood-and-metalworking tools in addition to a soldering iron to build this project. Furthermore, some of the parts for the radio will take a bit of hunting to find. High-impedance headphones, variable capacitors, and Fahnestock clips are definitely not stocked at your local Radio Shack! If your junk box doesn't have these parts, they are available through mail order. While you

are waiting for these parts to come in, you can be winding coils!

The coils L1 and L2 are approximately 250 µH each, and are designed for very high Q and low distributed capacitance. The coils are wound with 16 gauge enameled magnet wire with each turn spaced by roughly one wire diameter. The coils L1 and L2 must be wound on coil forms approximately 4" diameter by 7" long. Cornmeal is sold in cardboard boxes of this size. In my case, I happened to have some sections of thin-wall PVC drainage pipe of these dimensions which worked well, also. Drill the holes for mounting the slider bar and winding termination points as per Figure 3. If you are using cardboard coil forms, spray them with several coats of clear Krylon™ varnish before winding. Obtain 1-1/2 lb. (175 feet) of 16 gauge enameled magnet wire, which can be purchased at your local electric motor repair shop. You will also need a spool of cord or twine of approximately the same diameter as the wire to space the turns. Wind the wire and twine on the form at the same time, so that the wire and twine goes on in alternate turns. Start and finish winding leaving approximately 1/2 inch on each end of the coil form (65 to 70 turns). Loop the wire through the termination holes drilled in the coil form, and tie the twine off so it does not unwind from the coil form.

Next, spray the wound coil with a layer of Krylon™. When this is dry, unwind the twine, being careful not to dislodge the spacing of the turns of wire. Give the coil one more good coat of Krylon™ to fix the spaced turns of wire in place.

Install the winding terminal hardware as shown in Figure 4. Cut the ends of the coil windings about 1/2" longer than needed to reach these screws, and sand off the enamel insulation prior to assembling this hardware. Wrap the wire around the screw prior to installing the Fahnestock clip on the terminal screw.

It is necessary to remove the wire's enamel insulation from the section of the coils beneath the slider's path. Using an emery fingernail file, sand the insulation from the wire in a 1/2" wide strip beneath where the slider will mount. Brush the copper dust away so that no shorts result.

The slider assemblies are used to obtain the adjustable taps on the coils L1 and L2. The sliders will require some care in their fabrication. Figure 2 and Figure 4 show details of their construction. First, build the slider bars. Take the 3/16" square brass tubing, and cut them to the length of the coil forms. Then, drill a 1/8" diameter hole through the tubes 1/4" from each end. File down the burrs from these holes so that the 7/32" tubing can fit over the 3/16" tubing. The slider is constructed by cutting a 7/16" long section from the 7/32" square brass tubing. Carefully de-burr the cut end, and make sure that the 3/16" square tube will slide smoothly inside it. Solder the head of one of the 1/2," 6-32 flat head screws to the middle of one side of the piece of 7/32" tubing. Next, obtain a ball-point pen spring from which to form the slider contacts. (Note: the brass or copper colored springs will solder more readily than the unplated steel springs.) Straighten out the spring, and cut two, one inch lengths. Bend these pieces of wire into 'U' shaped loops, and solder these onto the sides of the sliders, so that about 3/16" of the loop extends below the slider tube. An alternative approach to the slider contact construction can be had if you have access to a section of copper fingerstock. A single finger may be cut off and soldered onto the square tubing for a ready made slider. Screw a wire-nut over the 6-32 screw on the top of the slider for an insulated handle. Slide the slider assembly over the 3/16" square slider bar, and mount the finished assembly on the coil form as shown in Figure 4. Space the slider bar up from the coil form with #4 washers so that the spring wire slider contact just grazes the wire of the coil. (Note: if you chose not to fabricate your own slider assemblies, they are available pre-made from Modern Radio Labs.)

Now, cut a 22" length of a 1" x 12" board on which to mount the whole assembly. This is the origin of the term 'breadboard'—old-time radios used to be built on wooden bases! From the wood remaining, cut two 4" by 6" pieces, and drill two 3/8" holes in each as shown in the diagram. Cut the 3/8" diameter dowel rods to a length of 24 inches, and insert the two pieces into the holes in the 4" x 6" blocks. Use a couple of finishing nails to affix these blocks onto the ends of the breadboard base. This forms the cradle which will hold the coils, and allow the distance between them to be varied.

As far as the assembly of the JFET detector circuit is concerned, construction is not critical. You may wire it up point-to-point, as I did, on brass brads driven into the breadboard. It may look pretty ratty, but fits in well with the overall aesthetics of the project.

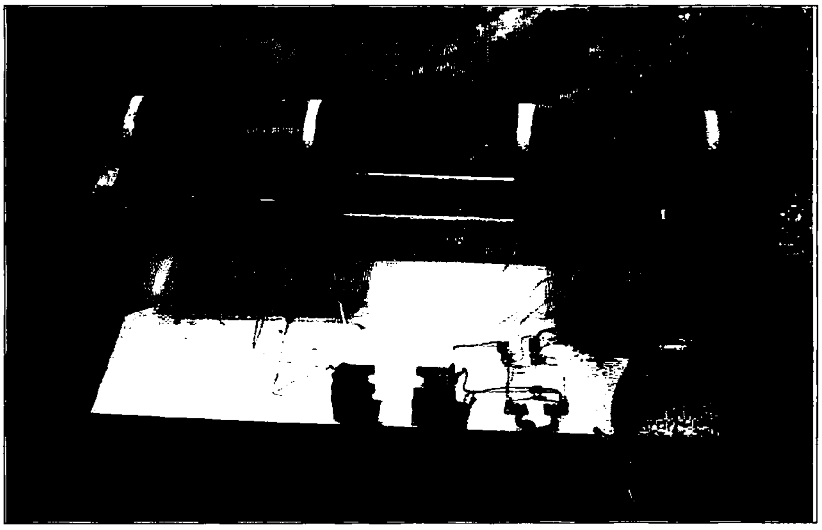
Notes On Parts

Undoubtedly, obtaining the parts to build this project will take more legwork than most of us are accustomed to. Unless you have a junk box as extensive as mine, you will likely have to hit some hamfests, or wait a few weeks for mail-order parts to arrive. But, be assured, that the thrill of operating this little receiver will make up for the time and effort that went into building it.

To obtain the square brass tubing needed for the coil sliders, try your local hardware store or hobby shop. Stores specializing in model airplanes, or radio controlled cars are likely to carry assorted brass tubing.

The variable capacitors C1 and C2 are standard 365 pF air variables. In recent years, these have become more difficult to find, but they are still available with a little searching. Antique Electronic Supply, Modern Radio Labs, and Fair Radio are good sources. If you don't have any lurking in your junk box, and don't want to go the expense of new units, I recommend you hit the local garage sales, and pick up a couple old tube-type, counter-top radios. These can usually be found for less than a buck, and are full of good salvageable parts for experimenters—in addition to variable capacitors.

The antenna for this radio is particularly important. The energy which



Assembled KC3ZQ Receiver

makes it to the headphones has to come into the antenna first, so if you want to go for DX, don't scrimp on the antenna. The general rule of thumb is to use as much wire as you can, and put it as high in the air as possible. If you are using a wire dipole for HF, a good AM broadcast antenna can be had by tying the center conductor and shield of the dipole feedline together to make the feedline a vertical antenna. Similarly, if you have a roof-mounted TV antenna, tie the ends of the 300 ohm twin-lead together to use the feedline as an antenna. The ARRL Handbook might provide ideas for antennas, but—use your imagination and creativity.

A good ground is equally important! But, most hams already have their shacks well-grounded, so this should not be a big problem.

Headphones are another area where good equipment makes a real difference in the performance of a crystal radio. A good set of 2000 ohm, high impedance headphones is essential. These can often be found in hamfests in used condition at quite reasonable prices—otherwise, Fair Radio, Modem Radio Labs, and Antique Electronic Supply each carry them. If at all possible, try to acquire a set of phones manufactured by Baldwin. These used a mica diaphragm rather than the steel diaphragm that most high-impedance phones had. They have a very well deserved reputation for sensitivity, and are worth the extra couple bucks you will have to pay for them.

You may also wish to experiment with a crystal earphone instead of the 2000 ohm headphones. These are less expensive than a new pair of 2000 ohm phones, and are roughly as sensitive. Crystal earphones are available from Mouser Electronics, Antique Electronic Supply, and Modem Radio Labs.

Fahnestock clips are the final touch needed to complete the project. Although they are not necessary electrically, they are a convenient way to hook up the circuit, and they do add a nostalgic touch to the project. They are available from Antique Electronic Supply and Modern Radio Labs.

Operating The Receiver

Once the receiver is assembled, and antenna and ground wires connected, it is time to give this rig a listen! Start off by setting the adjustments to nominal settings. Slide coils L1 and L2 so that their adjacent ends are about 4" apart, and set the sliders of each to about one-half of the way up from the grounded end of their respective coils. In adjusting the sliders, it is necessary to be careful that the slider contact touch only a single turn on the coil. If the slider is positioned so as to short two turns together, it will greatly reduce the sensitivity of the receiver. Set R2 to the middle of its range. Then, listening on the phones, turn C1 and C2 together until a strong, local station is heard. You may hear more than one station in the background. The detector bias voltage setting is particularly critical, so carefully adjust the detector bias control, R2, until the receiver volume is maximized.

I have found for this design, the best compromise of sensitivity and selectivity occurs when the adjacent ends of L1 and L2 are separated by about six inches. The selectivity of the receiver is also increased by adjusting the sliders toward the grounded end of their coils. For a long antenna, the best performance will be had with the L1 slider only a few turns from the grounded end of the coil. When increasing the selectivity of the receiver, there will be a point past which the volume of the signal will begin to diminish. It is at this point that the receiver will perform best. If you have access to a millivolt-voltmeter, it can be used to quickly find the optimum settings for the sliders. With the receiver tuned to a strong local station, by repositioning the sliders one way or another, and re-peaking the tuning capacitors, it is possible to find the position of the sliders giving the maximum detected carrier voltage across the headphones, which will be the most sensitive setting for the receiver.

So how does it work? Perhaps my station log might be some indicator of the performance of this rig. Using a 40 meter dipole at 30 feet as my receiving antenna, I was able to pick up KAAY, KOA, WSM, WMAQ, WSB, WBAP, WLW, WWWE, and a score of other mid-western clear-channel stations. Selectivity was such that I could easily separate KAAY (1090 kHz) from KHMO (1070 kHz). It is quite a novel experience to hear 'DX' on a crystal radio that one can't even hear on a more expensive transistor portable.

While I can say that my most memorable radio experience was listening to my first crystal radio, the fun of building and operating this latest one must come in a close second. I hope that anyone else who chooses to build one of these derives as much enjoyment from it as I did mine. And perhaps with it, you may inspire an inquisitive youngster into a lifelong love of radio, with a crystal set that will be nostalgia for the future. 73

Parts List:

C1, C2	365 pF Air Variable Capacitors	
C3	100 pF SM or Ceramic	RS# 272-123
C4	0.01 µF	RS# 272-131
R1	1 MΩ, 1/4 W	RS# 271-1356
R2	1 MΩ, Variable	RS# 271-211
L1, L2	250 µH tapped inductors—see text	
Q1	2N3819 JFET	RS# 276-2035
B1	9V battery	
	9v battery clip	RS# 270-325

Qty	
1-1/2 lb	16 AWG. Enameled Magnet Wire
2	3/16" x 12" square brass tubing
1	7/32" x 12" square brass tubing
2	1/2" x 6-32 brass flat-head screw
4	5/8" x 6-32 brass round-head screw
4	5/8" x 4-40 brass round-head screw
10	Fahnestock Clips
	#6 x 1/2" Sheet Metal Screws
	#6 brass flat washers
	#4 brass flat washers
	#6 bronze split-ring lock washers
	#4 bronze split-ring lock washers
2	Small wire nuts
2	Knobs for C1 and C2
2	3/8" x 3' wood dowels
1	1" x 8" or 1" x 12" board—at least 28" long
1	Spray can clear Krylon™ varnish
2	Coils Forms—see text

Suppliers:

Antique Electronic Supply 6221 S. Maple Ave., Tempe, AZ 85283
Fair Radio Sales 1016 E. Eureka Box 1105, Lima, OH 45802
Modern Radio Labs (My favorite source for hard-to-find crystal set parts) P.O. Box 14902, Minneapolis, MN 55414 Catalog $1
Mouser Electronics 11433 Woodside Ave., Santee, CA 92071

A Perspirational Message

by Wayne Green W2NSD/1 Editor

In my urging you to get up off the couch and make things happen, I often point out that hey, if I can do this, why not you? Some readers take this to heart and take up my challenge. Others just tell themselves that this is just Wayne bragging again. No, my ego is doing fine, it's yours I'm worried about.

The fact is that with very few limitations, you can do anything you really want to. My challenge is to get you to want to badly enough to get you to turn off the TV and then climb off the sofa. Yes, you can become an expert on digital electronics, if you want to. You can become a world-class expert on cold fusion. Or perhaps you'd like to become an expert horseman or race car driver? All it takes in the will to do it, which is an internal drive to succeed that I can't do anything about. You *can* stop smoking. You *can* lose weight, thereby adding years to your life.

I am an expert horseman, but I didn't do anything that you couldn't have done. It was a few years ago. I'd signed up to take a course in advertising put on by the Advertising Club of New York. That course has been invaluable for me. They should put that out on video. For some reason the members of the class decided to go horseback riding in Prospect Park, Brooklyn one Saturday. I'd taken horseback riding lessons when I was 11, but hadn't ridden much since, so I went with the group and had a great time.

I decided to get better at it, so I started taking lessons. Once a week I put on my riding britches and boots and took an hour lesson from an excellent instructor. I got to be pretty good. Then I got to be very good. So I bought an Arabian gelding and trained him so that I could ride without a bridle and he would stop, turn, go into any gait, back up and so on, all with imperceptible leg signals. Pretty soon I was teaching other riding instructors.

When I visited the radio station where I used to work in Sarasota (FL), I naturally went riding, renting a horse from the Ringling stable. When they saw I knew what I was doing they let me ride their star show horse, Starlit Night. That was fun for me, and needed exercise for the horse. If you let a poor rider ride a well-trained horse, it quickly untrains the horse.

You can get good at anything you want to the same way I did, through determination and perseverance. That's the same way I got good at race car driving. I took lessons from the Porsche professional racing drivers and I raced on some famous race courses (such as the incredible Nürburgring and the Solitude race track) in Germany. When I wanted to learn to ski I took some lessons locally to get started, then I went to Aspen and took lessons from one of the world's best ski instructors. Within a week I was skiing better than I ever thought I could. I was tearing down the expert trails, ready for anything.

When I wanted to get good at Chinese cooking I took lessons. Soon I was turning out spring rolls that were better than I could find in Chinese restaurants. And my spare ribs with black bean sauce on soft noodles was wickedly good. Every bit as good as anything Hong Fat on Mott Street was serving.

Any skill you want to build is going to take hard work. Physical skills mean finding good teachers and then keeping at it until you've built the coordination that lets you excel. Developing your mental skills usually means finding your teachers via books, since this gives you access to the best in the world, and not just those in your area

It's fear of failure which has kept so many older people away from computers. So what's been keeping you from getting involved with packet? It's certainly not the expense, which is modest. There's bound to be at least one ham in your area who's active on packet. Find him and get him to teach you. Once you've gotten going you can read more and then start talking with the experts in the field. This is where your *73* back issue collection will be priceless for you. The next thing you know you'll be an expert and working on ways to take the newer developments for the Internet and apply them to ham radio communications.

Anything they can do on the Internent we should be able to do on 20m, including ATV and duplex voice communications. It's we hams who should have been doing this pioneering, but we dropped the ball 30 years ago, so now we can at least apply technologies developed for other systems to amateur radio. Yes, if you want to, you can become an expert and pioneer on 20m ATV. I mean *you*, so stop looking around furtively.

The only things we fear in life are those we don't understand, if you think about it. Once we understand things we may respect them and be careful, but we'll no longer be afraid. I respect sharks, but I'm not the slightest bit afraid of them. So I'm careful when I'm swimming with sharks. It's only our ignorance which makes us afraid, and that's completely self-inflicted.

I'm very careful of high voltage. I learned that the hard way in 1938 when I was thrown across the room one night when I did something stupid. I survived (obviously), but I learned from the experience and it hasn't happened again.

You've been missing out on tons of fun via the ham satellites. Fear? It certainly isn't because it costs a lot of money, so it's got to be fear or laziness. Oh, you're too busy? Sure, I believe you. Well, I would, except that I notice that somehow you do manage to spend time on the things you really want to, so we're not talking time, which is a very lame excuse, we're talking motivation. Which is why I'm after you, month after month, to shake loose and restructure your life so you'll be able to build your physical and mental skills. And, via amateur radio, you'll be able to get to be an expert in fields which are in serious demand right now, and will be even more in the future.

Or perhaps you'd like to be king of the hill in DX? That's going to cost a bundle in both equipment and time, but the fact is that you can be a top DXer if you decide it is important to you. That means you need a good location with some room for beams and not many neighbors to beef about TV interference or sue over your ugly tower. It means at least a 70-foot tower, some monoband beams, and a kilowatt (minimum) amplifier. It also means you've got to build some skills. Signal alone will leave the mustard completely uncut. Or you can sit there with 100-watts and unlimited determination and collect just about every certificate ever issued, the way Howie W2QHH has for years. He could paper the Pentagon with his collection.

As Ray Croc, the man behind McDonald's, put it when he was writing about success, it doesn't take brains — there are too many brilliant scientists who can't afford a new car. It doesn't take education — look at the number of impoverished college professors. All it really takes is perseverance and you can have just about anything you desire. Do I have to sing "When You Wish Upon A Star" to get you motivated? "When you wish upon a star, makes no difference who you are, anything your heart desires can come to you. If your heart is in your dream, no request is too extreme. When you wish upon a star, your dreams come true." But you do have to back up your dream with plenty of hard work. Nothing is free that's worthwhile.

Health, wealth, happiness, and endless fun with amateur radio are all waiting, but not for the unmotivated. It's your decision. You can build skills and knowledge, or you can go watch ball games, swill beer, smoke, and waste hours a day numbing your mind with think-free TV garbage. It's your deal, so pick up the cards and let's see what your future holds.

Jan Mayen—A Special DXCC Country

by Roald Steen AJ0N/LA6US

The island of Jan Mayen is a volcanic island administered by Norway and located northeast of Iceland and about 300 miles off the coast of Greenland. Jan Mayen has become a special DXCC country with the prefix JW. Norwegian radio operators who operate from Jan Mayen use their Norwegian call, but replace the prefix LA with the prefix JW for Jan Mayen.

Jan Mayen is not a rare DX country, despite the small number of personnel on the island—usually less than 50—since many members of the island staff are engineers or technicians. One or more hams are active on the island much of the time.

I have worked Jan Mayen a few times on 20 meters from my home in Minnesota. I have also heard the island on the air during some of the Scantests (The Scandinavian Activities Test) which I have participated in, without being able to break through the resulting pileup.

The dormant volcano of Mount Beerenberg is the dominating feature of Jan Mayen. The peak of Mount Beerenberg, located on the Northeast end of the elongated island, rises to an altitude of 2543 meters (8347 feet). Glaciers cover much of the mountain. At several points, the glacier covers the mountain all the way down to the ocean.

The weather of Jan Mayen does not make the island an attractive destination for your next vacation. Most of the year, the island is covered by clouds and fog. Strong winds are frequent. These strong winds quickly blow away much of the snow that falls on Mount Beerenberg. Much of the outer surface of Mount Beerenberg therefore consists of ice instead of snow.

While the weather on Jan Mayen is not very hospitable, it is of great interest to weather forecasters. Observations from this island play an important role in European weather forecasts. A U.S. Weather Station operated from Jan Mayen for a few years beginning during the Second World War.

The staff of Jan Mayen consists of a small crew of Norwegian armed forces personnel, together with employees of the Norwegian weather service. They operate satellite communications and two way radio communications for shipping and air traffic control for aircraft overflying nearby airspace. The island's Loran C transmitter operates as part of a radio navigation system managed by the U.S. Coast Guard. The Loran C transmitter on Jan Mayen makes it possible to navigate across much of the North Atlantic Ocean.

The island facility includes a small ham shack, separate from the other buildings. There's a story about the time when a polar bear began to show a great deal of interest in the ham shack while the ham radio operator in it had forgotten to bring his rifle. He had to ask a ham in Norway over the radio to contact the appropriate Norwegian authorities. They contacted the island staff, informing them about the problem. They sent out a small "rescue mission" that used gunfire to chase the bear away.

Number 20 on your Feedback card

73 Review

by Gordon West WB6NOA

Alinco DX-70 HF/6m Transceiver

Surprises Everyone

Alinco Electronics, based out of Torrance, California, is best known for their single- and dual-band VHF/UHF handheld and mobile transceiver equipment, which is being sold by over 80 amateur radio dealers throughout the United States. Certain Alinco radios have achieved "fan club" status because of their unique design and relatively low cost.

For instance, there's the Alinco 1200TH2 9600 baud packet radio made popular by Buck Rogers packet column, the Alinco DJ-G1T first handheld ever with spectral channel-occupancy bar graph, and the Alinco DR-599 dual-band mobile with "secret" antenna jack for public safety 800-950 MHz.

While Alinco Electronics, Inc., does not enjoy the market share of Kenwood, Yaesu, and ICOM, the company does enjoy a reputation for good performing VHF/UHF equipment at prices slightly lower than the big three, and a small but efficient service team who can turn around most repairs at the Torrance, California, facility within ten working days. Allnco's technician/engineer, Taka Nakayama AB6VE, is extremely active on the ham bands and knows the equipment inside and out. "I love operating ham radio," comments Taka. "When it comes to 9600 baud packet, cross-band duplexing, or driving in downtown areas where intermodulation is a problem, I know how well our Alinco radios work because I'm active on the air," smiles Nakayama, who holds an Extra class US license and a Japanese license, too.

But Alinco Electronics really surprised the amateur radio community by coming out with a high frequency transceiver for the 1995 Dayton HamVention debut. "First we have VHF/UHF, and now we have high frequency, too," comments Alinco Electronics USA President Mark Morisato, KC6OCX. "And our new high frequency DX-70 does more!" adds Morisato. No doubt Mark means the built-in, all-mode, 6-meter, 50-54 MHz transceiver with 10 watts output that is included in the unit which is the same size as the popular Kenwood TS-50 mobile HF transceiver.

The new Alinco DX-70T HF plus 50 MHz all-mode transceiver runs 100 watts out from 1.8 MHz to 28 MHz on the ham bands, and tunes 150 kHz to 30 MHz continuously with its excellent general coverage receiver. Plus it covers 50-54 MHz, with all modes and 10 watts out. That's plenty of soup to kick a 6-meter power amplifier into "QRO."

Most unique is the detachable control head that allows the new Alinco DX-70T to be separated so the head can go on the dash, with the transceiver under the seat. The mike still plugs into the transceiver body, so separating the two can't be a trunk-and-dash affair. But I don't recommend trunk mounting of a remote-controlled transceiver anyway because of the long run of the DC power cable. This is just asking for trouble. If you need a longer mike cord they have an EDS-5 microphone extension cable that will handle the job nicely. Keep in mind that the extension cable will cost extra—probably about $40—so if you plan to run it remote, factor this in to the transceiver's street price, which will probably run around $1,250.

Yes, 6-meter fans, of course there's a separate output SO-239 antenna jack. When you switch to the 6-meter mode you can hear several relays go clink, telling you they are running an independent receiver and transmitter section for best performance on the 6-meter band.

I hooked the DX-70 to a 3-element tribander and regulated 12-volt power source, with the 6-meter side on a 3-element beam to see how the new radio would perform in the real world. The display popped up with a bold numerical readout of frequency: MHz, kHz, and hundredths. The numbers are slightly smaller than the Kenwood TS-50, but are bolder—fatter—darker. And like the Kenwood TS-50, there is a "busy" icon when the squelch is open, along with an amber LED that also lights up with receive activity. The mode indicator appears in the upper righl-hand corner, the AGC fast or slow appears above the frequency display. The VFO for memory channel shows to the left of the frequency. And more than enough audio to drive the top-mounted speaker.

As soon as I hooked into the tribander there was no mistaking that the Alinco DX-70 had a great receiver. It is dual-conversion, with sensitivity and selectivity numbers identical to what you might find on everyone's sales brochures for a $1,000 HF mobile SSB transceiver. But unique with the Alinco DX-70 is the bottom left RF button that lets you switch in the 10 dB pre-amp, switch it out, or switch in -10 dB and -20 dB attenuation. I found that the attenuator was a big help when operating on 40 meters with a neighbor one block away just 75 kHz up the band. On 10 and 15 meters I switched the pre-amp on which gave me a hot receiver.

The same button that controls the RF gain selection also has a sub-function, turning the noise blanker on and off. While the noise blanker does not have any timing or sensitivity adjustments, it did a nice job of killing the clatter of our next door neighbor's old Ford Thunderbird when he fired up the engine. The noise blanker didn't garble on extremely strong signals. On many HF transceivers, engaging the noise blanker on 40 and 80 meters will cause most signals over S9 to become garbled. Not so with this noise blanker.

Selectivity on SSB is 2.4 kHz, and a convenient "filter" button next to the RF gain button allows you to kick in the 1 kHz SSB filter. The 1 kHz filter is already built in, and not an added option if you want to tighten up on an incoming weak signal. You can further home in on an illusive signal by rotating the IF shift knob to dodge the QRM. This same filter network offers 1 kHz or 1/2 kHz CW passband. And if you're into shortwave listening, you can click in 2.4 kHz AM narrow, or 9 kHz AM wide—including FM—for full fidelity reception.

The first IF is 71.75 MHz, the second at 455 kHz, and spurious/image rejection is listed as 70 dB. When I switched back and forth between several transceivers on the bench, the Alinco was more sensitive and just as selective as the higher price sets.

Everyone commented on the recovered audio on SSB as being "sharp." It's the

same sounding audio I have heard from the Yaesu 900—nice full-fidelity treble without sounding tight or with a hiss. The DX-70, when tuned into a transmitting SSB station, is like listening to a hi-fi with bass, mid-range, and tweeters as opposed to an audio system with just a midrange speaker. It's hard to describe—listen for yourself.

The AGC is a function/AGC command on the same push button as the filter switch. The function button is conveniently located to the left of the set that makes it natural to depress with your thumb, using your forefinger for the other button.

I switched to 6 meters to confirm that all filters, noise blankers, AGC actions, and pre-amps weren't the same. I did notice on my big 6-meter antenna that 10 dB of pre-amp gain brought in a phantom sound of an FM or TV station way in the background that could never be tuned in. However, I didn't have that problem with the pre-amp turned on when I tested the unit on the mobile 54-inch whip.

I also tested the Alinco 6-meter receiver performance against a couple of other time tested 6m rigs and found the Alinco hotter on receive with the pre-amp clicked on than the other two units which I had running off of external amplifiers. And since the other two only ran 10 watts out, I didn't find the 10 watts from this Alinco to be out of line.

Mirage, now sold by MFJ, offers a 10-watt in, 150-watt out, 6-meter amp that I've seen selling for under $350, so getting more power is not all that difficult.

The front panel of the Alinco features a main tuning dial along with a smaller tuning dial. The smaller dial is rotated for memory channel select, megahertz or ham band select, and to change frequencies in specific kilohertz steps like 2.5 kHz, 1 kHz, or 500 Hz. This sub-knob reminds me of the click-click-click knob on the Kenwood TS-140. It's a handy feature. The main tuning knob resolves frequency down to 100 Hz (.1 kHz) dial indication, with 25 Hz steps if you ever-so-carefully turn the big knob.

The multi-function knob lets you quickly rotate through 100 memory channel locations which hold a surprising amount of memo-channel information: receive frequency, mode, any split TX, filter (!), AGC setting (!), RF gain amps or attenuators (!), noise blanker on or off (!).

This is a very smart memory that might allow you to independently select a CW frequency for fast AGC, narrow filter, no noise blanker, and RF pre-amp. On an SSB channel, you could memorize slow AGC, noise blanker, -10 dB attenuator, and the normal filter. I considered this versatile memory capability as a definite plus for this very compact rig.

Another nice feature is the high/low power output button. Unlike a slide switch or no power option at all, you can quickly reduce power to local stations or to reduce the current consumption of the radio on a dying storage battery.

There is a dial lock key to prevent you from accidentally turning the big knob when tuning channels in from memory. Like ICOM transceivers, memory positions allow for instant QSY from the big knob. This allows you to use the small memo knob to get you within a pre-set spot on the dial, and then use the big frequency knob. A quick flick of the small knob instantly puts you back to that original memory position. And when operating from the memory position for the digital modes, you would lock (electronically) the big knob to insure you don't accidentally bump off frequency.

Other buttons and knobs on the front would be the RIT capabilities; the "MF SEL" button to select memo, band, or frequency options; the little TX jewel LED that comes on for transmit; delta transmit; memory to permanent VFO selection; memory right, split, and priority—all the usual knobs on a HF transceiver.

If you press and hold the function key twice for longer than 2 seconds, "SE" will appear on the screen indicating you have set the Alinco DX-70 into the set mode. This is similar to the Kenwood TS-50 in the "menu" mode.

The multi-function small dial selects a whole bunch of set-up options.

The relatively large Alinco DX-70 English-written (!) instruction manual also gives procedures on a simple resetting of the mode settings, resetting all memory channels, simply resetting VFOs, or major reset that clears everything as if you had just purchased the equipment new from the dealer.

It gets better when you get to the back of the transceiver. There are the customary jacks for speaker or headphones, featuring the common miniature jack (not sub-miniature). There is the common CW jack for connecting a telegraph key or electronic keyer system. There's no built-in electronic keyer, but most hams prefer their own style of electronic keyer and never seem to like any type of built-in keyer. The CW key-jack is also a miniature jack, not the big 1/4-inch jack you would find on larger equipment.

There are also RCA jacks for ALC as well as relay. When the equipment is new out of the box, the relay is out of circuit. Cutting an obvious internal jumper wire, detailed in the instruction manual, lets the relay close when the microphone or key is depressed. The ALC input voltage from the amp needs to be zero to -3 VDC.

There's a small screw for connecting a ground foil tab, two antenna jacks plainly marked for HF and 6 meters, the heat sink, and then the power connector. More good news—it's the common 6-pin power plug that is used by Kenwood, Yaesu, and ICOM from a DC source.

There is an external antenna tuner connection which the book describes as being compatible with a Kenwood AT-50, a Kenwood AT-300, an ICOM AH-3, or even an SGC 230 automatic long-wire antenna tuner for field day/maritime mobile/mobile home applications.

While I didn't see an accessory jack for going digital, the microphone offers pin 6 as the detector output with associated pins for PTT, ground, mike ground, and 5 volts DC. Taka at Alinco, an avid HF digital operator, says this radio has full capabilities in the digital modes.

Power output on high frequency was a good 100 watts, and I noticed the average modulation level was around 60 watts, indicating only slight ALC action. This gave us a good punchy signal that everybody I worked commented about as being "hefty" and sounding great. The SWR protection circuit throttles back output down to 25 watts with no antenna, and a momentary antenna short-out pulled the power down to a safe 5-watt level.

On 10 meter FM the power output was also 100 watts. This surprised me because AM throughout the bands was only 50 watts. On 6 meters the power output was 15 watts SSB, 11 watts FM, and 6 watts AM.

I then tried operating on 10-meter and 6-meter repeaters, and everything was going along fine in entering the 10-meter 100 kHz offsets as well as the 6-meter 500 kHz offsets. But where oh where was the almost-always-necessary CTCSS selections out of menu? What, no subaudible tone encode? Oh yes, but it uses dip-switch programming.

The CTCSS encode is on the bottom of the transceiver, with no mention of it in the well-written and illustrated instruction manual. The tone board is included with the package, already installed, but you need your trusty toothpick and penlight to manipulate the 8 switches for any of 38 possible subaudible tones.

But besides that, I enjoyed operating the equipment. The only thing I couldn't figure out when running the unit without reading the instruction manual was how to get it to go into the set mode. As soon as I cracked the books, it was right there.

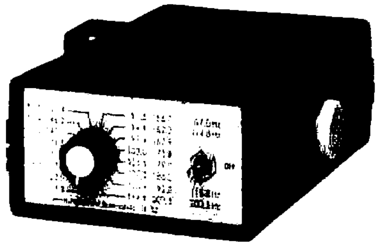
It has been many years since I have seen an HF transceiver with a VHF band included, so when you get a chance, head on down to your local amateur radio dealer and take a listen to the sharp high-fidelity action on the new Alinco HF + 6-meter transceiver. 73

73 Review

Number 22 on your Feedback card

by Larry R. Antonuk WB9RRT

TE-32 Multi-tone CTCSS Encoder



Imagine yourself traveling in a distant city. You and a non-ham friend are traveling to an important business meeting. You have some general directions, but you're not really sure where you're going. Reaching down to your mobile rig, you hit the scan button until the radio stops at an active channel. The conversation comes to an end, and you key the mic and call one of the stations. There's no reply, so you call again. Silence. Keying the mic a third time you notice that there's no kickback from the repeater, even though the strength of the signals would indicate that you're well within range. While you've been fiddling around with your radio, your friend has been reading a map; he tells you to get off at the next exit and take the first right turn. You arrive at the destination somewhat humbled, and certainly no better off because of your ham radio license. What went wrong?

Locked Out

Unless you have a broken radio, what went wrong is probably just the fact that the repeater you wanted to talk on needed a CTCSS tone to key it up. You may have heard of these tones at some point but really weren't paying attention. You don't need one for your home repeater, and even if you did your rig is a few years old—it doesn't have that feature anyway. But you sure needed that feature today. What exactly is a CTCSS tone, and why do some repeaters need them while others don't?

CTCSS stands for Continuous Tone Coded Subaudible Squelch, which describes exactly how the tones work. A subaudible tone is placed on the transmitted signal, just below the voice modulation. The tone is there all the time the transmitter is keyed, and it can control the squelch in the receiving radio. The CTCSS system was originally designed for commercial use, either to allow several companies to share a common frequency without hearing the other fleets, or to allow controllable access to community (multi-user) repeaters. Hams began to use the system in the late 70s, often to create "closed" repeaters. These repeaters would be open only to people who actually supported them. Supporters were given the proper codes, then had to add CTCSS capability to their radios. (Of course, an enterprising ham could simply decode the tone, and install this tone on his radio without paying to support the repeater. He would often find he had no one else on the repeater who would talk to him...) In the 90s, the use of CTCSS tones is mainly for preventing interference. As the bands get more crowded, more and more repeaters are going up. The frequency assignments for these repeaters are coordinated, but more often than not it's possible for mobiles in one state to be keying up their repeater, plus a second repeater in a different state, especially if the mobile happens to be on a high hill right between both the repeaters. The solution to this problem is simply to install a CTCSS decoder on at least one of the repeaters. Even though all the radios are still on the same frequency, the repeater will only key up if it hears a user with the proper CTCSS tone. The user chooses which repeater to access by changing the tone, not the actual carrier frequency.

What's the Key?

So what do you do if this happens to your hometown repeater? What if your rig doesn't have programmable tones? Maybe you're still using a crystal-bound rig, or even a converted commercial rig. Do you have to trade your rig in on the latest synthesized programmable whiz-bang unit? Of course not!

In the commercial two-way field, CTCSS tones are practically synonymous with Communications Specialists, Inc. The long time leader in CTCSS encoders and decoders, Comm Spec produces a multi-tone encoder designed exactly for add-on use, at a very affordable price. The TE-32 Multi-tone Encoder produces the 32 most common tones and is enclosed in a 5.25" x 3.3" x 1.7" cabinet with a bracket, ready for under the dash or under the shelf mounting. The TE-32 is based on the field-proven SS-32P board, which is a field-programmable CTCSS encoder designed primarily for installation in commercial mobile rigs. Usually programmed with a DIP switch, the SS-32 is slightly modified for use in the TE-32. Rather than the DIP switch, the tone frequency select lines are routed out to the front panel switches of the encoder. This allows easy access and instant changing of the tone frequency. As a matter of fact, the TE-32 consists of nothing more than the SS-32P, the rotary tone select switch, the toggle group select switch, and a nice box. There's plenty of open real estate in the box as well, but don't be put off by the small size of the unit. Communications Specialists products are all very well built, using custom-designed integrated circuits to keep things small and reliable.

How Do I Hook It Up?

All of the above may sound great, but you may be a little hesitant to rip your rig open and start poking around with a hot soldering iron. If you've never done any kit-building or electronic repairs before, you may want to get some help, but installing the encoder is really fairly simple. There are only three wires: + voltage, ground, and audio out (See Figure 1). In most rigs the power will not be a problem, as the TE-32 will operate within a range of 11 to 25 VDC, drawing only 12 mA. If your rig is somewhat more mature, the instruction sheet gives diagrams explaining how to power the unit off of 12- and 6-volt AC lines, as well as 200-VDC supplies. The power supply connections should be fairly straightforward, but the connection point for the audio may be a little trickier. The first thing to do is to check the schematic if one came with your radio (you did keep the manual somewhere safe, didn't you?). In many cases rigs were designed for add-on boards that weren't installed as standard equipment, and the tone input point will be clearly labeled on an existing plug or jack. If not, the best place to start looking is on or around the modulation control, usually on the center tap. This procedure is very well explained in the instruction sheet that comes with the TE-32. Once you have the connections all set, the only thing remaining is to adjust the output level. If you have a friend with a communications service monitor, great. Just set your tone mod at about 0.6 kHz deviation, and you're all set. If not, set the control to minimum and increase the level a little at a time until the repeater opens when you key up. Set the level a little higher than the minimum needed to open the repeater, but lower than the point where the tone becomes irritating. It's not unusual to hear a low level hum in the

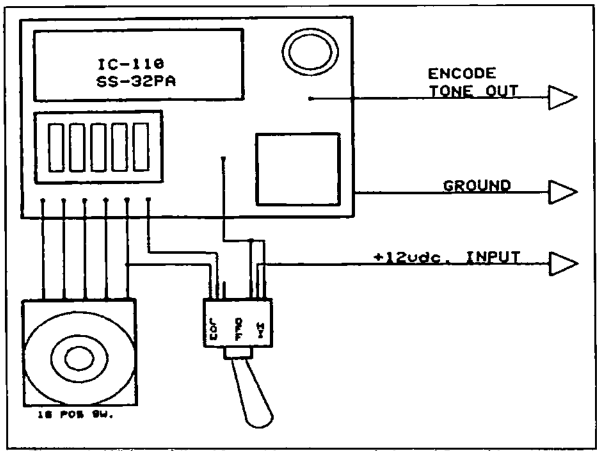


Figure 1. Wiring of the 16-position rotary switch and 3-position toggle switch to the SS-32PA CTCSS encoder.

background of your audio—that's the actual CTCSS tone. This will be more or less audible depending on the tone level, and the actual tone that you're using. (High frequency tones (203.5) will be more audible than the lower tones (67.0). As long as the level is low enough so people don't ask about "that power supply hum in your audio," you should be OK. Tie down the cables, mount the TE-32 under the dash, and you're on the air.

How Do I Run It?

Operation of the TE-32 encoder definitely does not require a degree in rocket science. The three-position toggle switch selects low range (67.0-114.8), high range (118.8-203.5) and no tone. You simply dial in the desired tone, and hit the PTT.

A Minor Drawback

Perhaps the only point that's less than ideal with the encoder is the fact that the frequency select switch is a sixteen-position unit. This makes the divisions a little close together, and it's difficult to see what tone is actually selected unless you're looking directly at the face of the unit. Not only that, but the rotary switch is a continuously variable unit—there are no end stops to start counting clicks from. Not a problem on the test bench, but if you mount the encoder in a mobile you may want to keep it close to the driver. (If you purchase the TE-32 for use around the same two or three repeaters you may choose to replace the sixteen position switch with a three position unit, and use a simple diode matrix to select the three different tones. This is also well documented in the instructions, but basically consists of pulling the proper lines low for each of the desired frequencies, and using diodes to provide isolation between the lines.)

A Good Choice

The Communications Specialists TE-32 Encoder is a winner all around. Based on solid field-proven technology, easy to install, well documented, and backed by a one year factory warranty, the unit is a very safe bet for anyone needing multiple CTCSS tone capability in a base station or mobile rig. Whether you need CTCSS capability for local repeater access, or you just need an evening project and want to give an old rig a new lease on life, the TE-32 is a good choice for the job.

Key It!

By Michael Jay Geier KB1UM

Chances are, you're using a modern, solid-state HF rig. Although there are still plenty of the older, tube-based radios around, by and large they've gradually been replaced by newer transceivers. Newer is better, right? Well, not always! In one respect, the old tube sets had a big advantage: they were easier to interface to linear amplifiers. Back in the old days, voltages were higher and the currents peripheral equipment was expected to need were higher, too. The transmit/receive switching in HF radios was just about always done with a relay, which gave you nice, high-current contacts with which to key your amplifier.

My, how things have changed! These days, most radios use solid-state T/R switching. Some do have small relays, but they often are only for the keying of external devices like amplifiers. So, what's the problem? Can't you just hook up your amp's relay and go? Well, sometimes, but it may not be that simple.

Can't Take It

Unlike with transceivers, linear amplifiers have not, by and large, been replaced by newer equipment. Sure, there are many new models around, but older amps are very durable, and there is little or no functional improvement to be had with a newer one, unless you buy one of the top-of-the-line microprocessor-controlled whizbangs costing many thousands of dollars. Consequently, many hams are using new radios with old amplifiers.

That leads to the common situation in which the keying transistor or reed relay in the radio simply can't handle the current required by the older amplifier's relay. So, how do you interface the two?

Many manufacturers provide optional, external relay boxes. These contain some kind of current amplifier circuit and a relay whose contacts can handle the required current for the amp. So, why not just buy one? Certainly, you can do that, but there are reasons why you may want to build your own. Ahhough most relay boxes are not particularly expensive, they may cost more than you feel like putting out, or they may have to be ordered, causing a long delay in your gettng your station set up. Or, perhaps, your radio is just old enough that they're not making the accessories for it anymore. Finally, you might just want to do it for fun, or to provide a current buffer for a radio which offers no relay box.

A New Approach

Nearly all solid-state radios key their PTT lines by pulling them from some nominal voltage, at low current, down to ground. In other words, they are designed to sink a small amount of current from an external device when you transmit. That method complicates the interfacing issue- it would be easier to design the current amplifier if the transmit signal went *up*, not down. Of course, the issue is not insurmountable, but it generally leads to the same solution: the use of a PNP transistor in the relay box. That works well enough, but it has a significant drawback: it forces your radio's PTT line to sink current, because the PNP design requires the transistor's base to be pulled down in order to turn the relay on. Is that a problem? Not always; remember, that's what the radio is designed to do. As long as you keep that current low, and you don't have too many other gadgets, such as RTTY or SSTV units, doing the same thing, it may work fine. But, you could force your rig to take too much current, damaging it. Or, you may put too high a

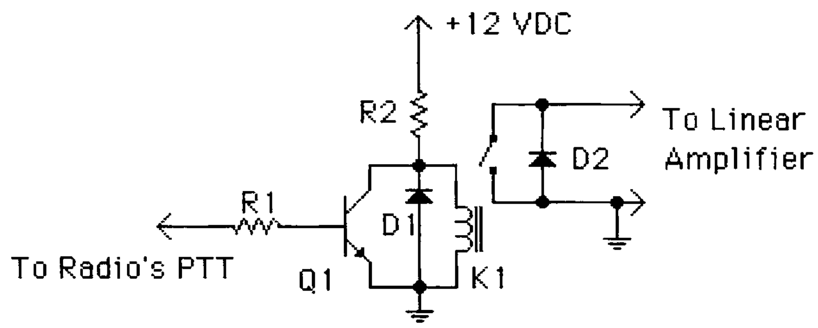


Figure 1

R1 10K
R2 See Text
Q1 2N2222 or similar
D1, D2 1N914 or similar
K1 Normally Open, See Text

voltage into it, which can cause damage if the keying is provided by a power IC which uses a supply voltage lower than the one you're trying to pull down.

I designed "Key It" with one objective in mind: it must not force the radio to sink current. So, I avoided the use of a PNP transistor, choosing instead an NPN. That, of course, makes the keying direction backwards. In other words, the base of an NPN transistor will turn on when the input voltage goes up, not when it pulls to ground. "Key It" gets around that problem by using the transistor in an inverting circuit.

How It Works

Take a look at Figure 1. The base of the current amplifying transistor connects through the 10k-ohm resistor to your radio's PTT line. It puts no current into that line. Rather, it takes a small current *from* the PTT circuit during receive! Connected across the relay coil, it pulls power from the station power supply, or the radio's accessory connector (more about that later), through R2, and effectively shorts out the relay, keeping it open. When you transmit, the input to the transistor's base goes to ground, causing the transistor to open. That lets the relay coil take the current, pulling in the relay and keying the linear amplifier via its contacts.

You might ask why I didn't opt to simply let the relay operate backwards and use its normallly-closed contacts. That would indeed make them open during receive and closed during transmit, but it would also have the secondary effect of keeping the relay closed most of the time. Why not do that? I've found that relays which stay closed too much tend to get magnetized and stick closed even when power to the coil is removed. For reliable operation, it's best to keep the relay unenergized as much as possible.

Calculating R2

In order to prevent overheating of the transistor, and also possibly of R2, it pays to keep the overall current down as low as possible. The key to doing that is to select a relay for K1 that needs little current to pull its contacts in. That lets you use a bigger resistor for R2, and also requires less dissipation by the transistor.

Assuming you're going to use a 12-volt supply, it's best to select a 6-volt relay, with as high a coil resistance as you can find. A reed relay is a great choice, as long as its contacts can handle the current your amplifier's relay needs. So, let's say you pick a 6-volt reed relay with a 1400-ohm coil. How do you find R2's value? Since you want to drop about half the supply voltage, simply use a resistor with the same resistance as the relay coil's: about 1400 ohms! What could be easier than that?

Most likely, you won't find one that's exactly the same. Probably, you can get within a few hundred ohms or so. If you have to choose a resistance value above or below the coil's value, pick one above. Heck, a 12-volt supply is really about 13.8 volts, and most relays will pull in quite reliably at voltages a little less than they're rated for, anyway. Remember, the aim here is to reduce the total current, and higher resistance does that. Choosing too low a value will cause the transistor to overheat, and may feed too much voltage to the relay, causing magnetizing and sticking problems.

In this circuit, just about any little NPN transistor, such as a 2N2222A, will work fine. If you want to be sure, though, you can calculate the transistor's required power dissipation quite easily: just find the total current, which is your power supply voltage (probably 13.8 volts) divided by R2. In this case, that would be 13.8/1400, or 0.0098 amp, or about 10 mA. Now, multiply that by the 13.8-volt supply voltage, and you've got your power in watts. Our example circuit requires just under 140 mW of dissipation in the transistor, making that 2N2222A a good choice.

Details

The only thing left is to add a couple of diodes to prevent damage from reverse-current spikes generated by the relay coils. I put one across the Key It relay's coil, and another across its contacts, in order to dampen out the spikes created by the relay coil in the linear amplifier.

If you use a fast reed relay, you can use this circuit for QSK operation, provided your amplifier can take that kind of use; most older amps cannot. Also, this circuit assumes a common ground between the 12-volt supply and the radio, and it also assumes that your amplifier is keyed by pulling its relay coil's positive voltage to ground. Both of these are the normal situations. If, though, your amp requires something different, you can still use Key It, but you may have to remove D2, or reverse its direction. Remember, it should always be connected opposite to the normal direction of current flow—be sure to connect the cathode to plus.

Earlier, I mentioned the use of the radio's accessory connector. You can use it to power this circuit, but be absolutely certain that the total current required by Key It is less than the accessory connector is rated to supply. In general, those connectors are meant for pretty low-current stuff, and may not be able to handle Key It. In that case, use your station's 12-volt supply, or even a little wall cube if you have to. If you do go the cube route, try one rated at about 9 volts; with the low power requirements of this circuit, the unregulated cube will probably be at about 12 volts anyway. If you use a 12-volt cube, it may supply more like 15 volts, which could be too much!

That wraps it up! Now, you can key that old amplifier without fear of harming your radio. You don't need high current capability from the radio, and you won't be asking it to sink any current, either. Truly, new meets old and both are happy!

73 Review

Number 30 on your Feedback card

by Dean Lewis WA3WGV

The Hamtronics RWWV Receiver

A precise, dedicated receiver for WWV.

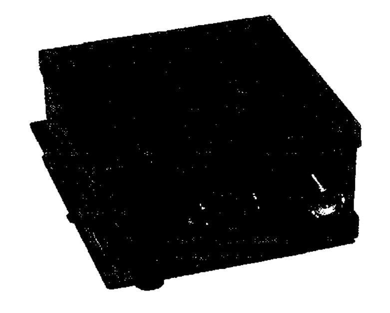


Photo A. WA3WGV put the Hamtronics RWWV receiver in this box

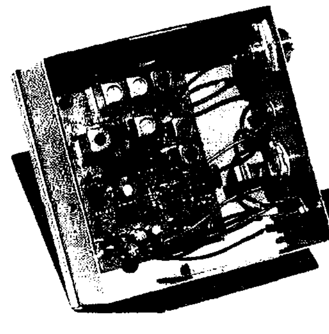


Photo B. The Hamtronics RWWV receiver circuit board

Time and frequency standards stations WWV and WWVH have been providing an "ail-news" format long before it was popular on broadcast radio. Hams, amateur and professional astronomers, laboratories, universities, and the military are just some of the users who rely on information available every hour that goes well beyond the familiar time ticks and audio tones. WWV's regular schedule of official announcements includes OMEGA Navigation System Status Reports, Marine Storm Warnings (storms at sea), Global Positioning System (GPS) Status Announcements, and Geophysical Alerts. These "Geoalerts" provide information on solar activity and the earth's magnetic field that affect radio propagation, and are of particular interest to hams.

Hamtronics Inc. of Hilton, NY, has produced a crystal-controlled board-level receiver kit for reception of WWV/WWVH on 10 MHz. Also available in assembled form, the receiver provides outstanding sensitivity and selectivity, but is easy to assemble and align.

Why a dedicated, crystal-controlled receiver for WWV? Many hams today work only VHF or UHF, many others buy or build the popular (mostly QRP) monoband CW or phone rigs, and in either case may not have an HF receiver covering 10 MHz. Anyone who monitors frequently will appreciate the size and convenience of a unit they can simply turn on and off as needed, with no tuning or adjustment. Amateur astronomers who rely on the accurate time signals will take advantage of the small size, simple and reliable operation, and strong audio output needed when working outdoors.

The manufacturer's specifications for the receiver are as follows:

- Mode: AM reception, 10.000 MHz, crystal-controlled
- Sensitivity: 0.2 µV for 10 dB s/n
- Selectivity: ±3 kHz at -3 dB, -50 dB @ ±10 kHz
- Image Rejection: 43 dB
- AGC: both IF and RF AGC
- Operating Power: 9–14 VDC, 80 mA at min. volume
- Circuit Board Size: 2-5/16 x 3 inches

Antenna input impedance is 50 ohms; audio output is up to 2 watts into an 8-ohm speaker. An optional squelch circuit is included to silence the output if the signal fades to an unusable level. An on-board volume control is included; a panel-mounted control can be substituted. The physical size of the circuit board lends itself to a variety of packaging methods after assembly.

The Circruit

The circuit board is FR-4, double-sided, with a continuous ground plane on the top surface; all holes are drilled and plated through. The board was obviously designed along the same lines as high-quality VHF/UHF circuits, which comprise most of Hamtronics' product line.

The circuit design is a straightforward superhet. Seven tuned circuits provide the selectivity, and intelligent use of integrated circuits provides high performance with a minimal parts count.

RF input at 10.000 MHz is amplified by a dual-gate MOSFET, then mixed with the crystal-controlled 10.455-MHz local oscillator output. After IF amplification and detection, the AF signal is boosted by a speaker driver IC. The detector develops two AGC signals. One of these controls gain in the IF amplifier stages. The other is used to bias gate 2 of the RF amplifier MOSFET. This signal is also used as a tuning indicator during alignment of the circuit, and operates the squelch.

Assembly

Assembly took about 4 hours, at a leisurely pace, double-checking each part before soldering. The process was a real pleasure: challenging, but with no problems. All parts fit perfectly. This was the best set of assembly instructions I've ever followed. The sequence in which the information is presented made assembly easier, and the Theory of Operation and Troubleshooting sections provided a thorough explanation of the circuit. Follow the assembly sequence just as specified; "landmark" parts first, then the smaller components are easy to locate. Although resistors and capacitors must later be fitted down between the IF transformers, it's not at all difficult.

Soldering was easy with a grounded iron, a 33-watt element, and a pencil-point tip slightly blunted with a file. When you are installing the integrated circuits, I'd suggest not bending the pins to fit the hole spacing, but insert one row of pins and "spring" the other row into place; it helps hold the IC to the board, thus keeping it from falling out when the board is turned over for soldering. For the off-board connections, stranded 22 AWG wire fits the holes perfectly.

One last suggestion: Before installing any parts on the board, lay it flat on a blank sheet of paper and trace a drilling template for the four mounting holes. This will be handy later, when you mount the completed board in an enclosure. If you already have the enclosure, trace the mounting hole positions directly.

Alignment

Alignment is accomplished by supplying an accurate 10-MHz signal and sequentially adjusting the tuned circuits, tuning for minimum AGC voltage. I don't own a signal generator. At the time I completed assembling the circuit and making the off-board connections, WWV's signal was very strong on another receiver; therefore, I initially tried aligning the circuit using only the off-the-air signal. Without going into the details, take my word for it: It doesn't work. The tuned circuits are just too sharp to start alignment this way. Having a few computer clock oscillators on hand, I connected 6 volts to a 10.0000-MHz unit and coupled it to the receiver's input through a .01 µF ceramic disc capacitor. After initial

adjustment of each coil, I disconnected the oscillator from the receiver and placed them next to each other, increasing the distance for a weaker signal each time I went through the sequence of tuning each circuit. This worked very well; tuning for minimum AGC voltage was easy. Because there is some interactivity among the tuned circuits, you'll want to go around several times.

For others who don't have access to a signal generator, I'd recommend the same alternative. Radio Shack doesn't carry the oscillators, but several mail-order sources exist, and major walk-in parts wholesalers have them. Cost is only around $4.00. The schematic and pin connections are illustrated in Figure 1.

Performance

I knew the receiver was working when I turned off the signal source oscillator and immediately heard WWV with only 8" of wire connected to the antenna terminal. A telescoping antenna brought in both WWV and WWVH that evening (WWVH ends their half-hourly identification message with "Aloha"; nice touch).

The audio level fills a room, without distortion, well before reaching maximum on the volume control; it easily drives even a large stereo speaker.

The AGC is a good feature, and much more convenient than I had imagined it would be. I used the on-board volume control, and I never need to touch it, even when switching from speaker to headphones. It's interesting to leave the meter connected to the AGC line and watch the signal strength as it varies due to propagation. An "S" meter could easily be added.

Of the several frequencies on which WWV transmits, 10 MHz was the right choice for a monitor. With this combination of a reliable frequency and a sensitive receiver, there have been very few days or evenings since I built it that the signal was not usable.

You'll want to build the circuit board into some kind of an enclosure. The small size lends itself to just about any kind of final assembly you prefer. I installed a 5-foot telescoping antenna (Russell Industries, Inc., 3069 Lawson Blvd., Oceanside, NY 11572, part no. W-3H, 11 sections, 60" extended, 6-3/4" collapsed), but have found that the full length is rarely needed for reliable reception.

If you don't plan to run the receiver indoors on a 12-volt power supply, eight AA alkaline batteries will last for many hours and fit easily with the circuit board in a small project box. An assembly option includes a (supplied) resistor for 9-volt operation. This battery is smaller, and should be adequate for typical brief listening periods. You could even build it all into a speaker cabinet; all that's

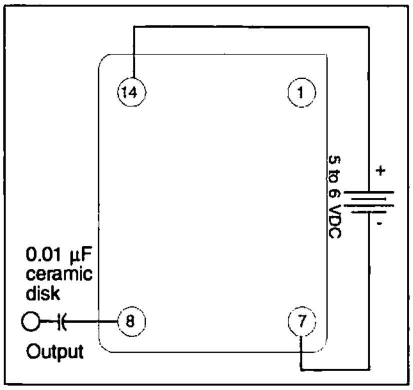


Figure 1. Clock oscillator pin-out diagram.

needed is an external antenna and on-off switch. If you don't like the austere look, add panel-mounted volume and squelch controls.

Summary

I don't believe you'll get better WWV reception on any other receiver. Add to that the pleasure of assembling a really well-designed kit of a finished size that can be packaged any way you want, and a reasonable price for the quality. The model RWWV is available in kit form for $59, wired and tested at $99, from Hamtronics, Inc., 65 Moul Road, Hilton, NY 14468-9535. Phone 716/392-9430; fax 716/392-9420. Now, who'll be the first to modify one for 30 meter CW?

A Milliohm Adapter For Your DMM

Expand your meter sensitivity

by Marion D. Kitchens K4GOK

The lowest resistance scale on most DMMs is 200 ohms, allow ing resolution of 0.1 ohms maximum. This is adequate for many purposes, but there are times when lower value resistances simply must he measured, and measured with greater resolution. A lot of problems occur around the shack because of poor pins and sockets on connectors, because of oxidized contacts on switches, and other similar circumstances. A particularly troublesome item is a relay with dirty or pitted contacts. Many small slide-type switches are notorious for fouled switch contacts. And we've all had unpleasant experiences with bad microswitches. It is often difficult to determine if the low-voltage winding of a power transformer is shorted or not, and sometimes center tap connections are not obvious. When the problem is a simple open or shorted connection, that is readily determined, but when partially open or shorted situations occur a way to measure low-value resistance is required. The milliohm adapter described here is quite helpful in those situations.

The adapter also serves a multitude of other purposes around the radio room and builders work bench. When designing high current power supplies, it is necessary to know the "internal" resistance of the windings. That property is seldom available, but can easily be measured with the adapter describe here. You can even measure the internal temperature rise of a transformer, by comparing the cold and warm resistance measurements. I suspect you could measure the resistance of a cold solder joint as well, but I could not find one to measure in my shack <Grin>.

The milliohm adapter is a simple, but effective test instrument. It is simple enough to be wired on perfboard, or a PCB can be made from the foil pattern provided. All the parts are available from most peg board sources like Radio Shack or JimPak. There is nothing fussy or critical about the components or in calibrating and using the instrument. The adapter can be powered from a wide range of supplies from 5 to 12 VDC, and because it consumes power (100 mA) only when actually making a measurement, battery operation is practical. The instrument plugs directly into your DMM for clutter-free operation as shown in the photo. The circuit design precludes the necessity of correcting for the test lead resistance, which otherwise would be a significant part of the very low value resistance this instrument is capable of measuring.

The milliohm adapter has two basic resistance ranges of 2.000 ohms full scale and 20.00 ohms full scale. The lower range results in a maximum resolution of 0.001 ohms, or 1 milliohm per digit of display on a 3-1/2 digit DMM. Thus the name of milliohm adapter.

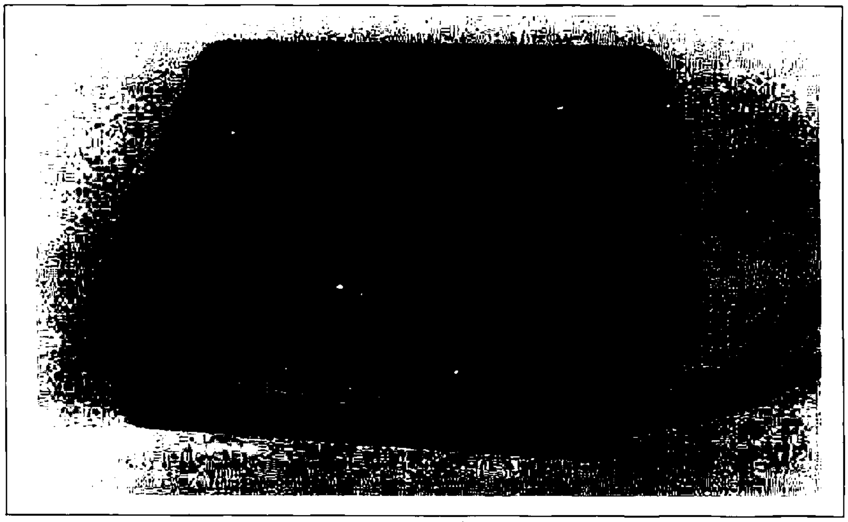


Photo A. Completed lilliohm adapter.

Circuit

Figure 1 shows the schematic of the milliohm adapter. The LM317 is operated in a constant current mode at 100 mA, set by the 15-ohm resistor paralleled with the 100-ohm trim pot. The two 2.2 MFD caps assure stability of the LM317. The circuit applies exactly 100 mA to the resistor under test, thus producing a

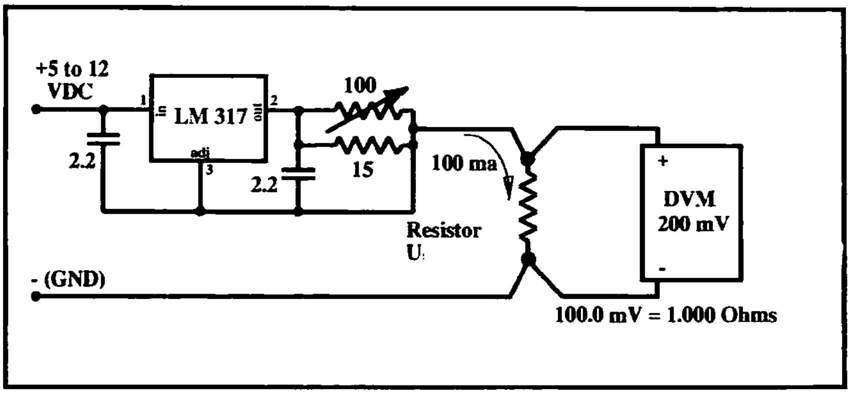


Figure 1. Schematic drawing.

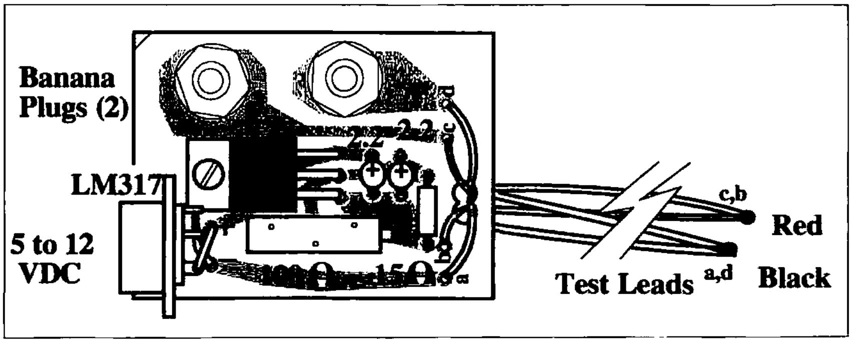


Figure 2. Parts placement drawing.

voltage directly proportional to the value of the resistor. The DMM then displays the resistance as a voltage. A voltage reading of 100.0 milli-volts equates to a resistance of 1.000 ohms. Note that this is a four-wire system, assuring none of the 100 mA current flows thru the leads to the DMM and thereby eliminating any affects of the test leads on the measurement.

Construction

Figures 2 and 3 show the parts placement and the PCB foil pattern, respectively. The PCB construction is recommended, but perfboard construction is quite adequate. The photo shows a finished PCB ready for test lead attachment and mounting. There is nothing critical or fussy about the layout, just keep the 2.2 µF cap leads short and close to the pins of the LM317.

Install the LM317 first and bolt it to the board with a 4-40 screw. Note the polarity of the tantalum caps and install them correctly. Add the 15-ohm resistor and the 100-ohm trim pot to complete mounting of the components. The holes for the banana plugs should be slightly oversize to allow alignment with your DMM jacks. Install the banana plugs in the jacks of your DMM first, and then place the PCB over the plugs and tighten the mounting nuts on the banana plugs. Note that only the metal part of the banana plugs are used; discard the insulators. Four nuts are required—2 on each side of the PCB, so you may have to purchase four banana plugs to get the nuts.

Mount a power connector of your choice on the PCB. The small coaxial connectors shown in the drawing and photos are recommended, but any connector you have will do. Make sure the power connector polarity is correct; there is no circuit protection for reversed polarity.

Make a set of test leads by twisting together two 2 foot long pieces of red wire, and soldering them together at one end only. You should have a 2 foot long, twisted test lead connected at one end only. Repeat that with two pieces of black wire for the second test lead. The four unsoldered ends of the test leads are soldered to the PCB at points a, b, c, and d as shown in the drawing. The two red test leads go to points b and c, and the 2 black leads go to points a and d. Study the drawing carefully to be sure the connections are correct. Your test clips or other connectors will be attached only after check out and calibration.

Check the PCB for solder bridges and unsoldered joints.

Check Out and Calibration

Apply power from a 5- to 12-VDC source. There should be no current flow from the power supply at this point in check out. Make sure that the supply positive voltage appears at the end of the red test lead, and that the black lead is at ground potential. Adjust the 100-ohm trim pot for a mid-range position. Set your DMM on the 200 mA current range, and connect it between the ends of the red and black test leads. The DMM should show about 100 mA of current. Calibrate the unit by adjusting the 100-ohm trim pot for a current of exactly 100.0 mA on the DMM. Note that best accuracy will be obtained if the unit is calibrated with the power supply to be used in normal operation. Disconnect everything from the milliohm adapter.

Plug the instrument into the DMM jacks and set the DMM for 200 millivolts full scale. Apply power, and the DMM should show an overflow. Next short the two test leads together directly at the solder joints (do not use clips or connectors on the test leads for this test), and the DMM should read 000.0 or 000.1 If the reading is more than 000.2, find the problem and correct it before proceeding.

Recheck that the current through the test leads measures exactly 100.0 mA with the mA meter connected between the red and black test leads. Attach test clips to the red and black test leads. Short them

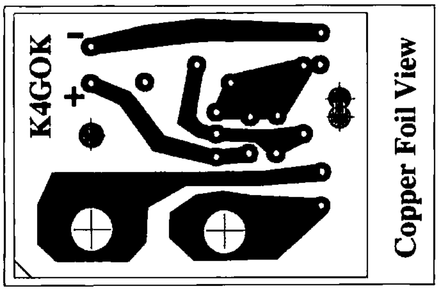
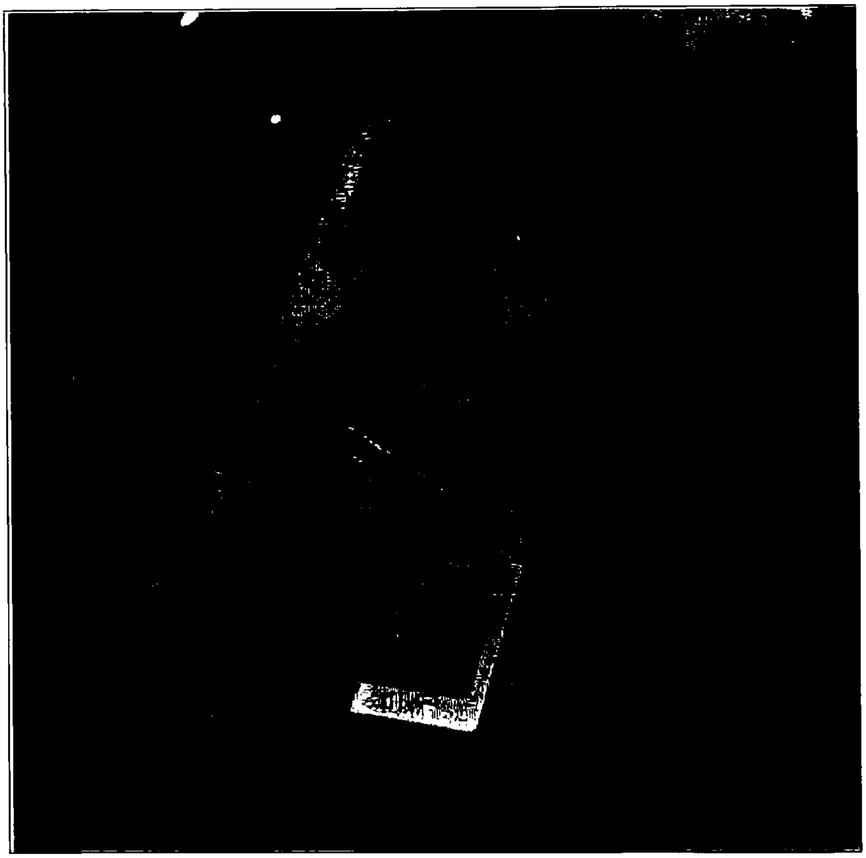


Figure 3. PCB foil pattern.



C. Adapter in use with Beckman DMM.

together and read the DMM on the 200 millivolt scale. Your DMM will now most likely read a small voltage. That is the resistance of your test clips and a measure of their connection quality. Wiggle the test clips for a better connection, if possible. The instrument is now ready to be mounted in a container and put to use. The photos show a completed unit mounted in a contained made from PCB material. Note that if your DMM shows negative readings (a minus sign), that can be remedied by reversing the test lead connections are points c and d'on the PCB.

Using the Adapter

Plug in the adapter, set the DMM to 200-millivolt range, apply adapter power, and make measurements! Note that this is a 4-wire instrument, and that for proper operation there should always be four wires directly to each resistance being measured—any other arrangement will cause errors. The test leads as recommended will assure proper operation. Also note that this unit actually measures voltage, therefore all power must be removed from the resistance being measured.

A Closing Note

The accompanying data chart provides some enlightening information. First those slide-switches with high resistance were dumped, immediately. Note the voltage drop the transformers will have at rated output. Some relays had quite high contact resistance, and they were all old, but unused. Gotta watch those relays!

milliOhm Adapter Data

K4GOK Mar 95

Transformers

30V @ 6A	0.16 Ohm
12.6 @ 1.2A	1.04 Ohm
12.6 @ 2.0A	0.56 Ohm

Switches

Slide	0.055 to >20
Micro	0.011 to 0.030
Micro	0.024 to 0.100
Toggle	0.009 to 0.021
Toggle	0.008 to 0.025
Toggle	0.013 to 0.031
Toggle	0.018 to 0.032

Relays

#1	Close	1.540 to 0.200
	Open	0.033 to 0.092
	Some	>> 20
#2	Close	0.022 to 0.022
	Open	0.200 to 0.530
	Some	>> 1.0
#3	Close	0.015 to 0.122
	Open	0.015 to 0.018
#4	Close	0.020 to 1.750
	Open	0.016 to 0.060
#5	Close	0.050 to 0.052
	Open	0.923 to 3.400
	Some	>> 20

NOTE: All Data is in Ohms

Table 1. Data Chart Showing Measured Data.

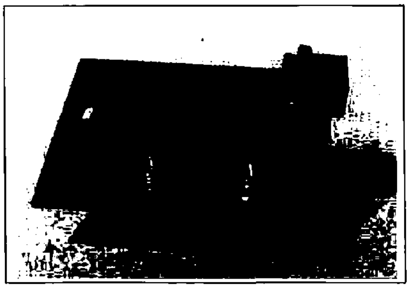


Photo B. Assembled PCB.Photo

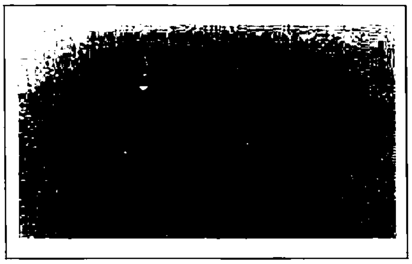


Photo D. Alternate view of assembled PCB.

QSY Internet!

A wide menu of information sources.

by Al Williams WD5GNR

It seems that wherever you turn today, you hear about the Internet. Mainstream magazines, network news shows, even the local newspapers seem to be talking more and more about the Internet. You can certainly use the Internet to find out yesterday's cricket scores, or the price of cheese in 1978, but you can also find online tons of information about our favorite hobby. If you aren't on the Internet, this article will show you how to get started; all you need is some sort of computer and modem or an ASCII terminal. If you are on the Internet, read on to find out where to find ham radio-related information.

What Can I Get on the Internet?

Here's just a sample of the ham radio information you can find on the Internet:

- Callbooks
- Satellite and shuttle orbits
- Ham programs for many brands of computers (PCs, Macs, Commodores, even Amigas)
- The latest FCC regulations
- Sample examination questions
- Recent DX station spots
- Propagation forecasts
- Repeater databases
- Hamfest and club listings

And that's just the tip of the iceberg. You can even talk to other hams in real time (like a RTTY QSO) or by using messages.

"The good part is that it is free; ask around to find out where the nearest Wormhole is."

How Do I Get All This Stuff?

Information on the Internet comes in many flavors. The data you want resides on a computer that could be anywhere in the world (a server). To get the data, you need to use the right protocol. The Internet supports many different protocols. Here are the most popular ones:

Telnet

When you use telnet, you log on to the remote computer directly. For example, some callbook servers operate via telnet. The initial screen indicates what user ID you use to log on. Then, the computer automatically runs the callbook search program. Your computer acts like a dumb terminal, in this case.

FTP

You use FTP to retrieve files from a remote host. When you use FTP to connect to a remote computer, it asks you for a user ID and password. By convention, most Internet computers allow you to log on as "anonymous" and supply your electronic mail address as a password. Then, you'll have limited access to public files on the host computer.

Web

The Web (or World Wide Web) is the latest word in Internet tools. A Web server stores pages of information. Each page can contain text, pictures, and even sound (see Figure 1). More importantly, a Web page contains links to other Web pages and Internet resources. A Web page on ham radio, for example, might have a link to a DX bulletin, another that runs a telnet session to a callbook server, and another that downloads a log book program using FTP. To use the Web, you usually use special software called a Web browser. You can use a simple text-only Web browser using nothing more than a Teletype. For personal computers, you can get sophisticated Web browsers that support text, graphics, sound, and even moving pictures. Most Web browsers can handle FTP and telnet, too. If you can use a Web browser, it may be the only Internet tool you ever use.

usenet

The usenet (or newsgroups) are similar to ordinary bulletin board systems (BBS). There are groups for everything from ham radio, to cigar smoking (no kidding). You can read messages from others on the subject and post your own messages. How you read newsgroups varies depending on the system your provider uses.

IRC

You can use IRC (Internet Relay Chat) to talk to other people (including hams) in real time. This is very similar to having a RTTY QSO, except there is no QRM, QSB, and TVI, the transmission is fast and error-free, and multiple people can talk at once.

The exact interface you use with these tools varies depending on your Internet provider. Figure 1 shows a typical Web page viewed with the Windows 95 Internet Explorer (a Web browser from Microsoft).

Ham Radio Resources

The Web is by far today the most important part of the Internet. Exactly how you access the Web depends on what tools you are using. Resources on the Web have a "Universal Resource Locator" (URL) that serves to identify it. You instruct your browser to "open" a URL. Then you can travel to other parts of the Web by clicking on that page's link. A URL has three parts. Here's an example:

http://www.qualcomm.com/amsat/AmsatHome.html

The first part of the URL, "http:," tells your browser that you are

accessing a Web page. Other choices here are "ftp:" or "telnet:", for example.

The next part of the URL is the computer you want to use (the host). In the above example, the computer is "www.qualcomm.com." The remaining part is a file name (including a directory). The example is for file AmsatHome.html in the amsat directory.

If you aren't using a Web browser, you can still access FTP and telnet resources. Just use the host and file names with your FTP or telnet program.

The following are some URLs that are interesting to hams:

URL	Description
http://www.clinet.fi/~jukka/webcluster.html	Real time DX spots.
http://acs.ncsu.edu/HamRadio	Page with links to many resources (repeater database, news, tests, packet, etc.)
http://www.libertynet.org/~adam/low-pro.html	Tips on operating from apartments or restricted homes
http://canada.unbc.edu/radio/	DX, propagation, packet information
http://www.qualcomm.com/amsat/AmsatHome.html	AMSAT satellite information
http://hypatia.gsfc.nasa.gov/sarex_mainpage.html	SAREX (Shuttle Amateur Radio Experiment) page
http://www.gate.net/~rlehman	SSTV page
http://wb5fnd.tech.uh.edu/irc	Information on ham radio IRC (Internet Relay Chat)
http://ftp.cs.buffalo.edu/pub/ham-radio	Many ham radio files
http://www.tapr.org/tapr/html/pkthome.html	Packet radio information
http://www.qrz.com/callbook.html	Callbook servers
http://promet12.cineca.it/htlzh/qsl.html	
telnet://callsign.cs.buffalo.edu:2000/	
http://acs.oakland.edu/barc/arrl.htmlC	ARRL home page

Searching the Net

The Internet is constantly changing. How can you find new things? How can you find items about other subjects? The best way is to use a search program. There are several Web sites that allow you to search for Web pages or access them via an index. Two powerful search programs are Lycos (http://lycos.cs.cmu.edu) and Yahoo (http://www.yahoo.com).

If a file you want appears in a Web page link to an FTP server, you can easily find it this way. If it is only in an FTP server, finding it can be more difficult. You can use a program named "archie" to find files on FTP sites, if you know the file's name (or part of the name). Otherwise, you can connect to FTP sites you think are likely, and see if they maintain an index file (usually, INDEX or 00_index). Download the index file and search it for the file you are interested in; many index files have file descriptions in them. Remember, if you are using a Web browser, and you want to FTP files from oak.oakland.edu (for example), just open the "ftp://oak.oakland.edu" URL.

Making Contact

Before you can access these services, you need to connect to the Internet. If you use packet radio, you may be able to gain limited access to the Internet via an Internet Wormhole. However, this is slow and doesn't offer many options. The good part is that it is free; ask around to find out where the nearest Wormhole is.

To get the most from the Internet, you need an account from a provider. If you live in a metropolitan area, you may find local providers. Table 1 shows the major national suppliers. There are four common types of accounts that use ordinary telephone lines:

1. Terminal
2. Proprietary interfaces
3. Direct SLIP
4. Direct PPP

When you use a terminal account, you use a modem and a terminal (or terminal emulator) to dial into the provider's computer. Then you use tools on the provider's computer. This is usually the least expensive way to get access. You can use any computer or terminal that will work with a modem. You don't need to maintain any software, since it is all on the main computer. If you use an older computer (a Commodore 64, for example), this may be your only option. Any computer with terminal emulation software can use a terminal account.

There are many drawbacks to a terminal account, however. Usually, it is not possible to use graphical Web browsers on a terminal account. You may be able to use text-only browsers, but you lose the full impact of the Web that way. Another problem occurs when you transfer files via FTP or the Web. The file winds up on the provider's computer—not yours! You'll need to use some file transfer software (XMODEM, for example) to move the file from the provider's computer to yours, a procedure that is just like getting a file from a common bulletin board system. If you use telnet or want to send electronic mail, a terminal account is as good as any other.

Many of the national providers (CompuServe, America Online, and so forth) use a proprietary interface to the Internet. You use their software on your computer to access their service. Then, by means of a series of menus or buttons, you can access the parts of the Internet that you want. These services often offer simplified access to common services, plus they usually have other services not related to the Internet. CompuServe, for example, has its own ham radio bulletin board that is independent of the Internet. Most of the major players have interfaces for the PC and the Macintosh.

If you opt for a SLIP or PPP account, your computer becomes a full node on the Internet for as long as you stay on the phone. This is the most powerful option since you control the software on your machine. It is also the most difficult to manage. You must set up your system to use a "stack" (software that manages the connection) and maintain all the Internet software you want to use. If you are using Linux, OS/2 Warp, Unix, or Windows 95, the stack is built in and you probably have several basic tools (FTP, telnet, and so forth) already on your system. If you run ordinary Windows or MSDOS, you'll find it is quite a job to install the stacks and get them working properly.

What to Look For

When you select a provider, there are several things you should consider:

1. Cost

There are many tiers of pricing available. The most convenient is when you pay a flat fee and can use the service as much as you like. However, it may be less expensive to pay as you go. Typical flat-rate accounts run about $35 per month in the Houston area, for example. You can also get a basic account for about $10 per month. For that fee, you'll get a few hours for free each month. Then additional hours will cost $1 or $2 an hour. Many providers have a free trial offer; be sure to ask.

2. Availability of local phone numbers

Be sure that the provider has local phone numbers. Otherwise, you'll pay long distance charges. Some

providers have 800 numbers, but you'll pay as much to use them as you'd pay the phone company for long distance.

3. Number of times you can use the service

Many providers offer unlimited access during nonpeak hours (evenings, and weekends). Others may surcharge peak hours or disallow access during peak times. Be sure to check if you want access during the day. If you don't need daytime access, try to get a discount on evening access.

4. Services available

If you get a SLIP or PPP account, see if the provider supplies any software (especially the stack). Otherwise, you may need to buy or find tools (FTP, telnet, a Web browser, and so forth) for your computer. Also check that the provider will accept electronic mail for you and forward it when you connect. This is essential since you are connected to the Internet only when your computer connects to the provider's computer on the phone.

Another issue is usenet. Your provider must "subscribe" to particular newsgroups for you to read them. Make sure your provider receives any groups you want.

If you opt for a terminal account, you need to be even more selective about available services. If your provider doesn't have a text-only Web browser, for example, you can't access the Web! Make sure they have satisfactory tools. The same goes for services with proprietary interfaces: What they have is what you have to use.

Many people want to put their own pages on the WWW. Some providers offer this for free, others charge a fee, and some don't allow it at all. If you want your own personal pages on the Web, be sure to ask if the provider allows it.

5. Hidden costs

Check for hidden costs: prime time surcharges, phone line charges, fees for disk storage, and so forth. If you want to publish a page on the Web, make sure there isn't an additional fee for this service.

6. Support

Usually, if you aren't familiar with computer networking, you are better off going with one of the major national providers with a proprietary interface. Their systems are easier to use, and they offer free support. Terminal, SLIP, and PPP providers expect you to know more about what to do and are less likely to offer detailed support.

Summary

With the explosive growth of the Internet, it is difficult to keep up with the daily changes. The best way to find out about the Internet is to get an account and jump right in! You'll find it a useful adjunct to your radio gear, and an interesting hobby in its own right.

Bibliography

There are many, many books available about the Internet. Here are a few to get you started:

Hahn, Harley. *The Internet Yellow Pages.* McGraw Hill, 1995. Like the regular yellow pages, this book tells you where to look for items on the Internet.

LeJeune, Urban. *Mosaic and Web Explorer.* Coriolis, 1995. If you use the Mosaic Web browser, you'll find this book very useful with information on the browser, web sites, and more. Includes a CD-ROM.

_____. *Netscape and HTML Explorer.* Coriolis, 1995.This is similar to the Mosaic book, but uses Netscape, a very popular Web browser. Includes a CD-ROM.

Pike, Mary Ann. *Using The Internet.* Que, 1995. This is a very complete book that comes with many Windows Internet tools on CD-ROM.

Vincent, Patrick. *Free Stuff From The Internet.* Coriolis, 1995. As the name says: how to get free stuff.

Table 1. National Internet Providers

Provider	Phone
America Online	(800) 827-6364
CompuServe	(800) 848-8990
Delphi	(800) 695-4005
Netcom	(408) 983-5950
Prodigy	(800) 776-3449
PSI	(703) 620-6651

73 Review

Number 41 on your Feedback card

by Stuart Landau K6YAZ

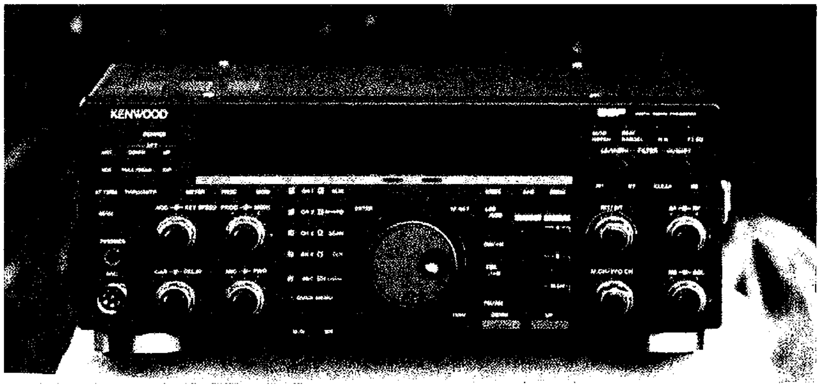
Kenwood TS-870S HF Transceiver

We are promised that conditions on the high frequency amateur bands are going to be getting better, with the startup of the next sunspot cycle. For now, the average ham, with a 100 watt station using antennas that are acceptable in an urban location, are having a difficult time working weaker stations through man-made and natural noise.

Certainly high power and large antennas will help, but many of us just can't afford to go that route. Antenna restrictions and interference to consumer electronics creates a difficult situation that we have to live with, or give up that part of our hobby. We need an edge to make amateur radio as enjoyable as possible, and I for one don't want to put off working the low bands until things improve, in a few years.

Kenwood has just released its newest and most advanced high frequency transceiver. The design feature that is unique in the amateur market (at least for now) is the use of a digital signal processor (DSP) that processes signals at the intermediate frequency (IF) as well as at audio frequencies. This has also been done recently by other companies making radios for the commercial and military markets (and their products may be purchased at great expense).

Kenwood was the first amateur radio company to design DSP into an amateur transceiver (in the TS-950 SD and SDX), and now they've expanded greatly beyond their original efforts, and they seem to have done it right! I've been able to copy signals on the TS-870S, buried in so much noise that I couldn't copy on other receivers, and that's what its all about. You can't work them if you can't hear them.



Description of the radio:

Lets start with the receiver, since it is what you would spend your time listening to, not the transmitted signal. It is a quadruple conversion type superheterodyne. The frequencies used are 1st: 73.05 MHz; 2nd: 8.83 MHz; 3rd 455 kHz and 4th: 11.3 kHz. All filters are included in the radio. The IF filtering is mainly done by the DSP. In addition to the DSP IF filtering, the radio contains nine crystal or ceramic filters located in the first three of the four IF frequencies, to act as additional bandwidth limiters. These are automatically selected by mode and operator-selected.

CW bandwidths range from I kHz down to 50 Hz in six steps. On FSK they range from 1.5 kHz to 250 Hz in four steps and on FM six different widths from 14 kHz to 5 kHz.

On SSB, slope tuning may be used, resulting in twelve different widths ranging from 1.4 kHz up to 6.0 kHz. Six bandwidths on AM complete the possibilities.

The reason that it is important to process the signal at IF instead of audio, is that once the signal has been detected, the DSP has lost a lot of the information that it requires to discriminate between noise and intelligence. For the most efficient transfer of voice or data, the receive filter must be matched to the transmitted signal, and predetection filtering is the optimum method. It makes little sense to have an overly wide bandwidth, and to attempt to make up for that by using a narrow audio filter. Certain artifacts will now ride along with the desired signal that make it very difficult to separate the desired signal from the noise.

A digital signal processor is a very specialized type of microprocessor. It crunches numbers, and in this case two DSP chips do it very quickly. In the receive mode, the analog signal is mixed down to a very low intermediate frequency of 11.3 kHz and converted into a digital stream of numbers. The DSP acts as IF filter, demodulator, AGC processor, squelch processor and—very importantly—as a noise processor. All of this occurs in a section of the radio which doesn't have any service adjustments!

When transmitting, the modulation with the exception of FM, is generated by the DSP, which also serves as a microphone AGC amplifier, voice equalizer, speech processor, VOX controller and sidetone generator. Whew!, what a busy region of the radio. Suffice it to say that this is one complex system

The DSP section of this radio consists of two Motorola DSP56002FC240 132 pin, 24 bit chips with a claimed dynamic range of 144 dB. The IF to digital converter is an 18 bit sigma-delta (also known as a one bit) A/D converter. The IF is highly over-sampled, resulting in a very quiet digital signal with a very large dynamic range.

The DSP IF filtering creates filters that have shape factors, pass band flatness, very high out-of-pass band attenuation and phase characteristics that are impossible to build any other way.

The transmitted signals are generated in the DSP, and mixed up several times to the transmit frequency, and amplified by the final amplifier unit. The RF portion of the transmitter, for the most part, is very similar to that of the TS-850S.

The frequency synthesizer consists of three phase lock loops and three direct digital synthesizers, all controlled by a CPU. A 20 MHz crystal oscillator serves as the only reference oscillator in the radio. The result seems to be a very fast, quiet radio.

Using the radio:

My approach to writing the evaluation of the radio was to ask friends of mine to use the radio, and give me their

opinions. I didn't expect a consensus, but I think several opinions and observations are valuable.

While this radio is user friendly, it will require studying the instruction manual and practice to be able to take full advantage of the radio's unique features. It's not a beginner's radio. It would be a waste of money to buy a piece of equipment such as this and not be able to take full advantage of what it has to offer.

The TS-870S comes with a built-in antenna tuner and doesn't require (or will accept) any additional IF filters, all are already synthesized by the DSP. A sophisticated CW keyer is also included with the radio. It will operate from six to sixty words per minute, and emulates the K-1 Logikey. A normal key or paddle is all that's needed to get on CW. The radio will store four CW messages with a total of 220 characters. This sounds like a great feature for contesting. Options include a voice synthesizer, a digital recording system, and a high stability temperature-compensated crystal oscillator. An 8.83 MHz full bandwidth IF output is provided on the rear panel to be used with a station monitor such as the older Kenwood SM-220 or current SM-230.

DR Ulrich Rohde KA2WEH, well known for his communications books and articles in amateur publications was a consultant for Kenwood on the design of the receiver. His insistence that PIN diodes, rather than silicon PN switching diodes be used in critical spots in the receiver front end, has resulted in a receiver with great immunity to overload. He had the use of a pre-production radio this summer and the opportunity to make some sophisticated measurements. I use his results with his permission.

Phase Noise: -120 dBc/Hz at 10 kHz, -126 dBc/Hz at 20 kHz

This indicated a very quiet frequency synthesizer, resulting in a narrow transmitted noise signal, and low reciprocal mixing in the receiver.

Third Order Intercept Point: 22 dBm with AIP on.

Second Order Intercept Point: 64 dBm with AIP on.

This indicated the ability to reject interference when there are many strong signals inside and outside of the band.

Dynamic Range: 95.3 dB with AIP on, 91.6 dB with preamp on.

Ulrich said to me that he considered the receiver in the TS-870S the best currently available at its price.

The display is similar to that currently used in the Kenwood models TS-950SDX and TS-450S. It is a good-looking multi-colored display, carefully thought-out to help the operator. The only shortcoming of this type of display is that is very hard to see in bright sunlight. I've used both the TS-450S and the TS-870S in my car, and while most operators won't use this radio mobile or outdoors, it's something to consider.

Unlike all other Kenwood High Frequency radios, the front feet don't raise up. If you want the radio to tilt up to face you, you'll have to put something under the front or build a ramp. The main tuning knob now has a rubber cover around the outside and a depression on the front for your finger, but doesn't have any adjustable friction adjustment. There are two tuning rates available on the main knob, and a much faster rate using the M.CH/VFO.CH. control. I find the rate and feel to be very comfortable. Push-buttons either light up when they are in the on position, or light up an indicator on the display to indicate the state that they are in.

The instruction manual is very well-written and illustrated. The introduction and one page of the appendix explains something about the DSP and how it is used. Also included are sections on standard time stations, the NCDXF/IARU beacon network, HF beacons and the short-wave broadcast bands. The remainder of the appendix explains the digital interface for computer control (using RS-232C).

Computer Control Of The TS-870s:

The TS-870S includes a built-in RS-232C port and comes with two 3.5 inch floppy disks, containing a DOS- or Windows-compatible software program called Radio Control Program™. RCP will allow complete control of the radio via a personal computer. It will let you use or create a "virtual radio" on your screen. As long as you can provide a two way communications path at baud rates of from 1200 to 57600 bps, and audio lines, you can completely control the radio, and locate it anywhere! Optional software modules are available from DynaNet Corporation. The 870S can also transfer data (receive frequency and receive mode) to another 870S or four other types of Kenwood transceivers.

The microphone supplied with the radio is the MC-43S hand mic., the same that has been used for many years. This microphone provides up and down buttons for changing frequency or memories, but no "soft keys" as on the TS-50S and TS-60S microphone. I would suspect that most buyers will opt for some sort of desk mic.

The TS-870S is a descendent of the TS-850S. The dimensions are exactly the same and at 25 pounds weighs only one pound more. Someone comfortable with the operations of the 850 would feel at home using the 870.

At a list price of $3199, and considering the typical dealer discounts, the selling price shouldn't be much more than the TS-850S, especially if you loaded up the 850 with a bunch of IF filters.

Best points:

- The ability to survive in a crowded noise filled band.
- Many bandwidths in each mode without having to buy additional filters.
- It is also a well-thought-out contest radio. The built-in antenna switch, so that two different antennas can be used, even in the same band.
- The provision for an additional receiver to share the same antenna as the one currently in use by the 870.
- One of the features we liked most was the ability to adjust the transmit voice frequency equalization and voice processing to produce the best sounding signal for an individual voice, and to monitor the results. The reports on the air impressed many.
- It was also agreed that the noise blanker (which is adjustable from the front panel) was also very effective.
- An innovation which also received a good review was the ability to program the receiver for a very fast AGC release time on CW. When working a weak DX station being called by very much stronger local stations, the receiver would almost instantly recover from the stronger stations.
- The antenna tuner is a real improvement over anything that Kenwood has offered in the past. First it's very fast. Whether you're just changing bands and the tuner is going to a memory location or you are attempting to match an antenna, it just takes a few moments to tune and stop.

The numbers in the book don't indicate the apparent range of impedances that it is able to match. I was able to match a twenty meter mobile antenna on both 40 and 15 meters as well as the intended 20 meter band. At home, a random length dipole matched on most bands. Of course matching isn't everything, a non-resonant antenna still is usually a poor radiator, and a tuner isn't going to change that.

In another novel change from the Kenwood past, the antenna tuner may also be used during receive. This will result in greater immunity from QRM caused by strong out of band stations, and if your antenna isn't well-matched will raise the received signal strength. I had modified my TS-440S auto tuner years ago to do this, and found it be a worthwhile feature, especially when operating mobile.

The antenna tuner has 18 preset memory frequency segments. This enables you to have one setting for the CW portion of most bands and another for the phone portion. In addition you can preset either antenna connector 1 or connector 2 (ANT 1, ANT 2) for the same portions.

Frequency Bands

While the receiver covers the entire range from 30 kHz to 30 MHz, the transmitter will not operate outside of the U.S. assigned bands—not by even ten hertz! MARS and CAP modification data will be available for those properly licensed.

This radio contains a 68 item menu, which enables you to set up the radio exactly the way you want it. This also eliminates many panel or hidden controls, such as VOX, CW pitch, display dim and more. There are actually two main menus, A and B. They are the same, and may be set separately for different situations such as normal operating and contesting. You can switch between them at will. Also you can assign the most often needed menu functions to a quick menu for fast access, without calling up a main one.

When you temporarily want to return the menu to the default settings, it can be done by turning off the power, holding the CLR button and turning the power on. To return to the original settings, turn off the power and turn it on again.

The front panel meter serves up to six different functions, and consists of a multi-colored curved bar graph, that looks somewhat like a mechanical meter. An unusual feature is that the relative bandwidth and position of the pass band

tuning is graphically displayed. This is a really nice feature because it instantly shows how the receiver filtering is set up.

The receiver sports three new buttons which use the unique features of the DSP. The first button is AUTO NOTCH. This introduces an automatic very deep notch in the receiver IF to eliminate a heterodyne that may interfere with a SSB transmission. By doing the processing at IF rather than at audio, a strong carrier won't capture the AGC, and reduce the desired signal's strength.

The second button is called BEAT CANCEL. Used on either SSB or AM this button enables an audio notch filter that will reduce or eliminate interfering tones. This function is also more effective at removing low-level tones than AUTO NOTCH.

The third button is called NR or noise reduction. This uses the DSP on All modes except FM to improve the signal to noise ratio of received signals. A different method is used on voice modes than is used in CW or FSK. An adaptive filter analyzes speech patterns and forms a variable filter around the received signal. Kenwood calls this method Speech Processing/Auto Correlation (SPAC). On CW and FSK the preferred method is the Line Enhancer Method or LEM.

Negatives

Like any new product, some things will require time and experience to perform the best they can. The radio that I had for evaluation was a pre-production model, and some of the minor things my fellow evaluators and I didn't like may be taken care of in production:

- It will take some study and practice to master.
- The poorly contrasting display in sunlight.
- Lack of extending front feet.
- It was reported by some that the receiver audio was distorted and lacked adequate frequency response.
- The radio doesn't include a power supply but requires a separate DC power supply capable of delivering 13.8 VDC with a current capacity of 22.5 A or more.
- An internal speaker is mounted on the top cover and it sounds all right, but I would recommend a good quality external speaker or earphones for serious operating.

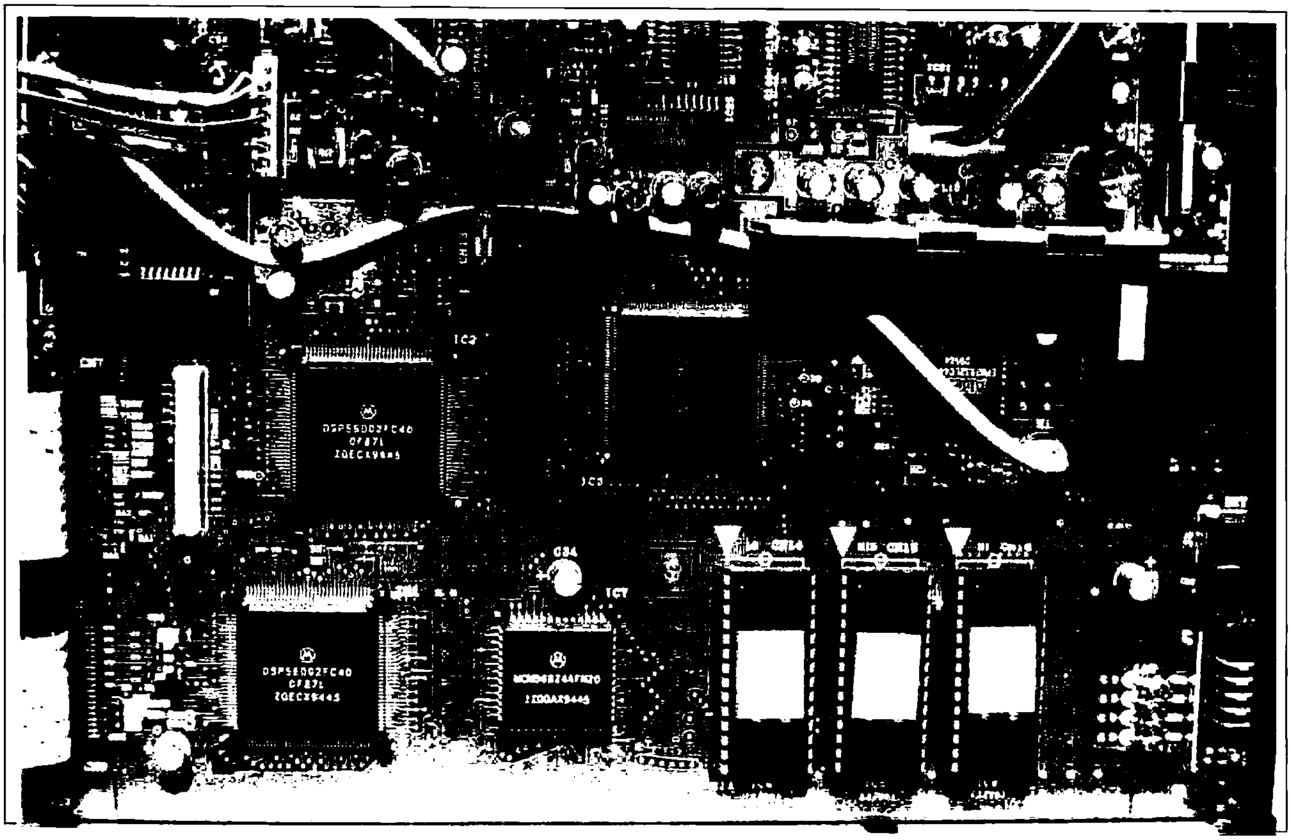
Buying a major piece of radio equipment such as the TS-870S (or any other radio) requires an informed decision on the part of the buyer. I would certainly suggest that you spend some time in front of the radio, and see if it is able to do what you want it to. What seems wonderful to someone else, may not be what you need. Talk to others who have used the equipment and then make your own decision based on your own needs, tastes and experience.

A friendly piece of advice from someone who has worked on a lot of amateur radio gear: If you have trouble with a sophisticated radio such as this, don't try to repair it yourself, and don't take it to "Mr. Fixit". There are very few service adjustments inside, and it takes special tools, a lot of experience, good test equipment as well as the service manual to make it well again. This is no place for guessing and substitute parts.

Biography

First Licensed in 1956 as a novice (KN6YAZ) while in Jr. High School, Stuart Landau now holds an Extra Class License, K6YAZ. He has worked in commercial television, aerospace, and communications electronics, and is urrently working as an Engineer for Standard Communications Corp., working on land mobile radio and marine electronics products.

Mr. Landau would like to thank Randy Powell, NZ6N, Al Mandel WB6RGF and Ulrich Rohde KA2WEH for their help with the evaluation. And a special thanks to the people at Kenwood for the loan of the radio along with the documentation and software. *Comments to: (818) 203-2080*



Inside the TS-870S HF Transceiver.

A Problem Under The Aurora Borealis

(Or, a ham's Christmas Fable from our Hamily to yours!)

By the Reinhardt Family, Jeff KM6II; Melissa KD6BIT, Jessica KD6ARA and Steven KE6PNA
(Just a little south of the North Pole, according to Steven)

In a quandry about selecting a personalized call sign? You aren't the only one. Selecting a call that's just right is a problem that reaches from your house all the way to the North Pole!

Santa found himself in a real dilemma. "This is worse than the years with no snow," he thought to himself. There before him was a blank form he had been staring at for at least two hours. "This is silly," he mused. "I'm falling behind on reading letters from the children, the elves need some assistance and supervision, the reindeer need feeding and all I can think about is this blasted form."

"Why the worried look, Dear?" Santa smiled at the voice of Mrs. Claus, which always sounded so soothing. "It's this personalized call sign thing," he replied. "I need a ham call sign that's distinctive and an identifier like no other. Ever since this has been kicked around in a few countries, it's caught on like wild fire."

"Well, why don't you get up and think on it while you do a few chores," she said, picking up a plate with but a few remaining cookie crumbs. "I'm sure the exercise will do you good, with only a few days remaining before Christmas."

Santa made his way out to the toy shop. There he encountered his busy assistants merrily working away. He asked Mike what he thought a good call sign might be. "Hmmm, how about something cute, like P1XIE?" Santa smiled. "That's a good start! Any more?" "Well, there's L1ST, which we work from, K1DS, who we work for, STØCKG which you stuff, DØLLS for the girls, TR8NS for the boys and the G1FTS that you bring!" Santa chuckled, "All good ideas, my faithful friend!"

Thinking on the suggestions, Santa wandered over to Kit, his weather forecaster. "How are things looking for the 24th, Kit?" "Looking great, Santa, should be just right for a sleigh ride. But why so distracted?" he asked, noting that Santa's mind seemed to be elsewhere. Santa related the personalized call sign problem. Kit, an avid DX chaser, said, "No problem! In my line of work I get call sign ideas all the time!" "Like what?" asked Santa. "Well, in a few days your sleigh will make its way through the DR1FTS, and the FL8KES, the air will be FRØSTY and there will be plenty of SNØW. And you remember a few years ago when it was so FØGGY? That often happens in W1NTR. Great night for one of the R8NDR as I recall!" Santa flashed a broad smile that caused his wire-rimmed glasses to rise on his nose. "Kit, you've convinced me there are plenty of good call signs to choose from. And as a citizen of the world, I can use any prefix I want!"

Kit's comment about the reindeer reminded Santa that he had to make a trip to their barn. On entering he saw Morris, a trusted helper who loved the four-legged friends. Santa asked Morris if he had any ideas on a custom call. "Well, as you know I love CW and that's why I like these reindeer. They talk to me!" "They do?" said Santa incredulously. "Indeed—listen to their hooves on the wooden floor."

Santa had always dismissed the reindeer's tapping as a restlessness to take to the night sky, but listening more closely, Santa heard some distinct calls in Morse code—"That's CØMET!" he exclaimed. "And there's DØNNR, hmmm QP1D!" he roared. "D8SHR, VIXEN, BL1TZN, D8NCR, and PR8NCR!" But a noise from the corner sent him into gales of laughter, "Oh, I couldn't forget you, Rudolph," as the hoof tapped out RNØSE. "But I can't believe you boys are so good at CW." Santa laughed again as they all tapped out SL8GH together.

He left the barn still roaring when he passed the familiar landmark, a snow-covered post in the ground, with a red stripe reminiscent of a candy cane. "By golly, I can get in the spirit of this, too," he thought. "Why right there is a good call sign, NPØLE!"

As he made his way into his office, thoughts of Christmases past came back. His mind was really working now, as he began to doodle on a piece of paper...CH1MNY...hmm, has possibilities...RØOF...no, but he smiled, remembering he would have to duck under a few antennas while up there...BØWS, maybe...BØXES, no...KR1S or KR1NGL?...one seemed to need the other...N1CK? Maybe.

He did some letter reading and flipped on his radio. After listening to one 80 meter rag-chew, Santa turned it off musing that for some of those hams CØAL might be a suitable call sign in their future! He left the office, tired but cheered by the productive evening. As he passed under the roof overhang he wondered aloud about IC1CLE as he saw one hanging there, but dismissed the thought. He made his way back to the kitchen and Mrs. Claus was humming a song. "K8ROL" he said to himself. But Mrs. Claus heard him and said, "Still working on that call sign thing, dear?" "Yes," he said. "And I've had some splendid suggestions, but I still haven't heard one that really does it for me." "Well I've had some ideas, too. Care to hear them?" "Of course my love." She handed him a plate and a glass of milk." On the plate there's one of your favorites, COØKIE. Eat too many and you'll be RØUND!" "I already am!" They laughed together.

Mrs. Santa then showed a dreamy look in her eyes, "How about NØEL?" Santa smiled warmly, "That's closer, he said." She continued, "There's always J1NGL; how about HØLLY? No? Or the many JØYS you bring? And remember, G1VER is you down to a dimple," she said. "JØLLY describes you well. And let's not forget the SØOT I have to get out of your clothing!" Santa laughed aloud and he said, you've done it my dear!" "SØOT?," she inquired? "No, you have me laughing...he walked over to the license form and filled out HØHO on the first request line. "They should know me all over the world by this one!" They hugged and both reflected on the beauty of laughter and giving and how they fit together so well.

(The authors apologize if any of the aforementioned call signs are already in use, but remember, Santa was only brainstorming. And if one of the calls is yours, how lucky you are! Merry Christmas!)

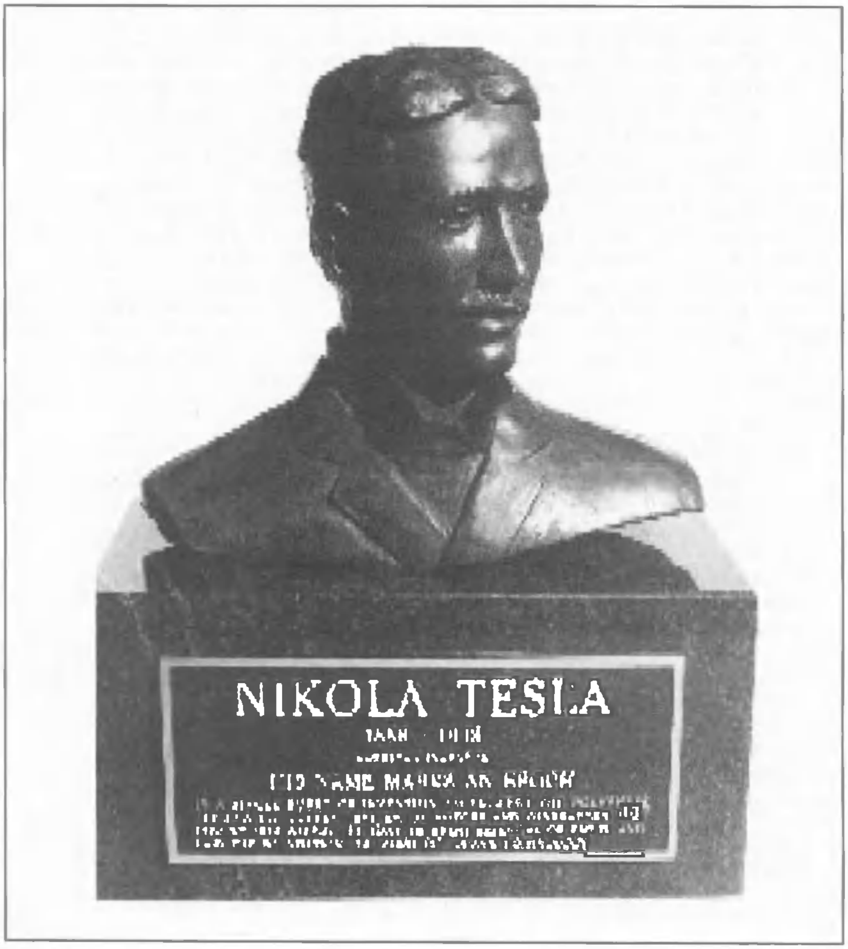
Nikola Tesla, The First Radio Amateur

And the real inventor of radio

John Wagner W8AHB

Nikola Tesla was born in 1856, and by the time he was 26 he had invented the rotating magnetic field principle. This discovery made possible the generation and distribution over long distances virtually unlimited electrical energy in the form of 60 cycle alternating current. This included the invention of the ac generator, the ac motor, and the transformer.

He then moved on to explore the world of high frequency phenomena. By 1890 he had conceived his famous "Tesla coil," still used as a major component in numerous electronic devices. By 1893 he had conceived, explained, and demonstrated the "four-tuned circuits," using the theories of Maxwell and Hertz for the transmission of intelligence. The circuits were tuned to resonance with each other, two on the transmitting side and two on the receiving side, using a Geissler tube detector. His apparatus used the first antenna, as well as a ground connection, plus an antenna-ground circuit containing inductance and capacity. Yes, he invented the tuned circuit! In 1893 he made the first "wireless" transmission before the National Electric Light Association in St. Louis, and it is this essential understanding that exists today in all modern radios. These principles served as the foundation for his U.S. patents that eventually had priority over Marconi's basic patents.



Most amateurs are unaware of what happened June 21, 1943, when the United States Supreme Court made a landmark decision that essentially settled the long dispute between Marconi and Tesla. The court's decision on Case No. 369, identified as "Marconi Wireless Telegraph Company of America vs. United States," rendered invalid Marconi's basic patent No. 763,772 dated June 28, 1904. Tesla's patent No. 645,576 of March 20, 1900, and its subdivision patent for apparatus No. 649,621 dated May 15, 1900, had priority. The court also cited John Stone's patent No. 714,756 dated December 2, 1902, incorporating greater tuning selectivity, and Sir Oliver Lodge's patent No. 609,154 dated August 16, 1898, providing variable inductance tuning.

The following definition served the Supreme Court well because it was then able to render a just decision: "A radio communication system requires two tuned circuits each at the transmitter and receiver, all four tuned to the same frequency." It is this "four-tuned circuit invention" that Tesla patented. This enabled the high court to give him priority for these necessary basic elements of "wireless," without which there would be no foundation for future advancements.

Most historians tend to attribute the birth of radio to the early technologists who made the first refinements, but it was Tesla who had laid the foundation. Historians also give great praise, and

correctly so, to such men as Maxwell and Hertz for their monumental work in wave theory. Unfortunately, Tesla's greatest contributions, AC power distribution and fundamentals of radio have largely been forgotten.

It is easy to understand why so many people have a distorted understanding of just who was the real inventor of radio. The newspapers hailed Marconi's first successful transatlantic radio transmission; then textbooks followed with their depiction of that exciting event. Both media sources had already raised the flag of victory for Marconi, much to Tesla's dismay, since he had done much of the pioneering work.

A similar media blitz is responsible for Thomas Edison becoming a familiar household name. In reality Edison did not create or develop our system of alternating current electricity. Indeed, he fought its adoption bitterly, choosing instead to promote a direct current system that had already been invented by others. In short, Edison's brief role in the electrical power industry was that of an entrepreneur who failed, rather than an inventor. It was Nikola Tesla's discovery of the rotating magnetic field principle in 1882 and patented in 1888 that gives us our modern day system of electrical power distribution.

In 1988-89 my students commissioned a bust of Tesla to donate to a large museum (any large museum). After discovering that the Division of Electricity and Modern Physics section of the National Museum of American History made no recognition of Tesla, we offered our bust. The curator promptly refused the offer, stating that he had no use for it. Later we discovered that he was displaying a bust of Edison alongside Tesla's induction motor. He also displayed photographs of the Niagara Falls power plant next to one of its original generators. A large brass inscription plate listed Tesla's patents, but with no mention of Tesla. In the middle of the display stood a life size replica of Edison with the caption, "While the Niagara AC plant was being built by Westinghouse, Edison was busy with other important things." The caption did not explain what these "other important things" were, nor why this was relevant to the Niagara power plant.

The *Smithsonian Book of Invention* is a prodigious 3/4 inch thick book of America's greatest inventors and their inventions. Tesla's name does not appear anywhere in that publication. One wonders how such an august institution, with all the learned historians in their employ, could possibly ignore Tesla's contributions in their chapters depicting the evolution of electric power and radio.

Further evidence of history being rewritten is seen in the Smithsonian's publication, "The Beginning of the Electrical Age," which meticulously traces the history of electricity from Volta to Edison, naming 43 significant contributors, and yet Tesla's name is never mentioned! Instead, it shows pictures of the Niagara Falls Power project with the inference being that this was the work of Edison. Yet it was Tesla's polyphase AC system that the power commission adopted and licenses had to be issued to use Tesla's patents. Since the money for this publication came from the Thomas Alva Edison Foundation, perhaps this explains why Edison's name and pictures appear so prominently and Tesla's name is missing. History, it appears, is indeed for sale at the Smithsonian.

Radio amateurs especially should take exception to the flagrant disregard for truth in history that exists in the Division of Electricity and Modern Physics section of the National Museum of American History, within the Smithsonian Institution. Why does the Smithsonian have such a biased view of electrical history?

Tesla's induction motor, using his rotating magnetic field principle, provides us our worldwide system of alternating current electricity. Few people realize the earthshaking importance of this discovery. Honored engineers have ranked it the electrical equivalent of the wheel.

Niels Bohr in 1956 stated, "Tesla's most ingenious inventions and researches have been fundamental for that development which so deeply influences our whole civilization."

Dr. W. H. Eccles, in the *Proceedings Of The Institution Of Electrical Engineers*, stated, "Tesla was the greatest electrical inventor we have had on our roll of membership; in fact we might go as far as to say that he was the greatest inventor in the realm of electrical engineering."

John Stone in 1917 stated, "Among all those, the name of Nikola Tesla stands out most prominently. Tesla with his almost preternatural insight into alternating current phenomena that has enabled him some years before to revolutionize the art of electric power transmission through the invention of the rotary field motor, knew how to make resonance serve, not merely the role of a microscope, to make visible the electric oscillations, as Hertz had done, but he made it serve the role of a stereopticon. He did more to excite interest and create an intelligent understanding of these phenomena than any-one else, and it has been difficult to make any but unimportant improvements in the art of radio telegraphy without traveling, part of the way at least, along a trail blazed by this pioneer who, though eminently ingenious, practical and successful in apparatus he devised and constructed, was so far ahead of his time that the best of us then mistook him for a dreamer."

Lord Kelvin in 1896 stated, "Tesla has contributed more to electrical science than any man up to his time."

Tesla was recognized by his peers, but then largely forgotten.

Tesla died in 1943, alone in his hotel room at the Hotel New Yorker, surrounded by a world of technological progress he was instrumental in creating. Yet the only monument to his memory in our country is a statue at Niagara Falls, a gift from the former country of Yugoslavia. He is one of only two Americans honored by the International Electrotechnical Congress in Munich. In 1956, the unit of magnetic flux density in the MKS system was designated the tesla. Thus, his name is alongside only fifteen others such as Volta, Faraday, Ohm, Watt, and Ampere. Joseph Henry is the only other American so honored.

For those who are old enough to remember, the Smithsonian Institution carried on a similar feud with the Wright Brothers that lasted 45 years. It was not until December 1948, after we had entered the jet age, that its officials finally relinquished their demand to honor Samuel P. Langley, whose plane did not fly. He was Secretary of the Smithsonian in 1903, when the Wrights flew their plane at Kitty Hawk.

At best, I hope to build enough support from the amateur radio community to petition the Smithsonian officials to honor Tesla. Certainly there is overwhelming evidence that he has earned his place in history in our country's premier museum. At the very least, this issue might stimulate some lively discussions on the ham bands.

Note: *Tesla was, in my estimation, the single greatest genius in history. In addition to inventing electricity as we know it and laying the groundwork for radio, Tesla also invented the electric clock, the loud speaker, the fluorescent lamp, and a long list of other firsts. At a time when the text books were claiming that voice could never be transmitted by radio, Tesla was planning a world radio broadcasting system, and was building a tower on Long Island to transmit free electric power. The electric companies, seeing this as a serious threat to their making and selling electricity, got together and put Tesla out of business. Please help put pressure on the Smithsonian to recognize this incredible genius.—Wayne.*

Number 50 on your Feedback card

HAM TO HAM

Dave Miller, NZ9E
7462 Lawler Avenue
Niles, IL 60714-3108

Two months have passed now since we inaugurated this column within the pages of *73 Amateur Radio Today* magazine. Input from you, the reader, has begun to materialize, but we still need a much more enthusiastic response in order to fill this space with the very best of information that's available. We're looking for tips, ideas, suggestions and techniques that will help our other readers in their pursuit of amateur radio. Whatever you feel might be helpful, things that you've discovered in your own ham career that have proven worthwhile, both technical and from an operational standpoint. Everyone has something to contribute, the key to unlocking the idea for the rest of us to share is to sit down and write to me about it. Make your point as clearly as you possibly can, including all details, schematics, sketches, etc. Whatever you feel would be helpful to get your point across to others. One of the secrets to making sure that your written suggestion clear, is to have a friend read it over first, preferably one who's not familiar with the idea. If he has any questions, then you'll know what else you'll need to include for best clarity. We're looking for workable, proven ideas and suggestions, ones that will be repeatable by others with the same or similar problem and ones that haven't been published elsewhere. Send your contributions to:

73 Magazine's Ham To Ham column

c/o Dave Miller, NZ9E

7462 Lawler Avenue Niles, IL 60714-3108

For each idea used within this column, Uncle Wayne will send you ten real U.S. dollars for your time, trouble and postage costs, but the real satisfaction is in knowing that you'll have helped others benefit from your experiences and knowledge.

If you've sent in ideas and suggestions to other publications, only to be ignored or forced to wait for months—years?—to even receive a response, I can guarantee you that it won't happen this time. I'll acknowledge all legitimate contributions expeditiously, giving the contributor an idea of whether his or her idea will be used, and roughly when. Nothing turns people off more quickly than to have their ideas and suggestions viewed with indifference...I know...I too have been ignored at times by other publications. I promise you that it won't happen here, it's one of the reasons that I first contacted Uncle Wayne about starting this type of column in the pages of

73. We need a place where good ideas are valued enough to be treated respectfully, and this is it.

There are tons of good ideas out there. With all of the equipment now available to the average ham and all of the different and varied modes of operation, any number of problems and their solutions have to have been discovered by Joe or Jane average ham. These are the ones I want to hear from. The dyed-in-the-wool engineers and contemplative theoretical physicists are welcome to send their thoughts, ideas and drawn-out treatises to the other magazines. We're looking for real hams with solutions to real ham-related problems, within the down-to-earth context of our hobby. As the masthead says, Ham To Ham, not physicist to physicist or theoretician to theoretician.

By the way, I've no problem with engineers, physicists or theoreticians particularly, it's just that I don't think that most other hams are really all that interested in long, boring soliloquies on concepts that can be explained much more succinctly. Brevity in explanation is often the key to understanding; it's surely the key to staying awake after a long day at the salt mines while you sit back and read the latest issue of *73*. Not everyone who reads a magazine like this one, or who holds an amateur radio license for that matter, is an engineer, nor may they be involved whatsoever in the electronics profession on a day-to-day basis. I've the feeling that most of the folks who might be reading this just want a straight-forward solution to a perplexing problem within the hobby, and that's where this column is heading. If this is vastly different from your own interests in the pursuit, try to step back and view it from that perspective. Now, if what I've said is already your viewpoint, or you can at least momentarily make it your viewpoint, then sit down and write about some of the things you've run into with commercially made equipment, antennas, station accessories, etc. and send them in to me. Knowledge is only usable if it's in understandable form. *73 Magazine* has always had the reputation of being a practical showcase for real hams, with real, duplicable ideas and articles. Let the others print things that no one wants to read, build or do, we'll stick to actual reality, not virtual reality.

When you do contribute ideas to this column, however, please try to be fair to the manufacturer of the item if you have a suggestion for an improvement Everything ever made can be improved upon. Equipment manufacturers often sacrifice one feature for another, or they may drop something because of cost and competitive design reasons. We're usually wrong if we consider everyone other than ourselves to be fools! We're also definitely not looking for unsubstantiated complaints nor libelous accusations about any particular manufacturer or company. That's not the purpose of this column. Our purpose is simply to help others who might be experiencing the same or similar problem with a piece of gear, with the thought in mind of fixing the problem, not fixing the blame for it.

Anything in and around the ham shack is open for acceptance on this page. We're all involved in electronics in general, as well as in amateur radio specifically, so consider sending in ideas that may not seem solely for use in ham radio—though I do want to keep the main focus along the ham equipment lines. In fact, my first tip this month is something that reaches beyond the ham shack and into the world of TV's, VCR's, etc. as well.

A Simple Infrared Control Verifier

Some of the current ham gear is showing up with infrared remote control capabilities, just like the vast majority of new TV sets, home VCR's, stereo audio setups, etc. Infrared headsets and microphones have also invaded the ham shack in the interest of keeping desktop cable clutter to a minimum.

Here's a simple way that you can verify if your hand-held infrared remote transmitter is at least putting out a signal when a button is depressed, since our eyes can't see an IR beam of light directly. By the way, many of the problems with infrared remote controls can be traced to a faulty hand-held transmitter unit. Either a button(s) not making good contact, dead batteries or batteries making poor contact or a cracked PC board from one too many drops on the floor! But to test it, all that you really need to do is to tack an IR detector diode across the input of any high-gain audio amplifier, turn up the amplifier's volume, aim the remote transmitter at the diode's face, and you'll be able to hear the pulses being sent out by the IR transmitter. That's it.

Any high-gain audio amplifier that's usable down to microphone levels should work—such as the Radio Shack #277-1008 portable battery operated test amplifier. The IR detector diode can be one-half of an infrared emitter/detector set, such as the IR detector diode in the Radio Shack #276-142 combo. Even a glass encased 1N914 or 1N4148 silicon switching diode can be pressed into service, but it's much less sensitive than a real IR diode—did you know that all glass-encased diodes are somewhat light sensitive? They're temperature sensitive too, but the ones specifically made for light or temperature sensing are specifically formulated to enhance those particular properties.

Painting Antennas

I can remember overhearing a conversation on the ham bands one day—between two fellow hams who seemed to know each other fairly well—on the virtues and drawbacks of painting a new 2-meter vertical antenna that one of them was planning on putting up soon. The one putting up the new vertical asked the other if he thought that painting his new antenna, to help preserve it, would be okay. The second ham

Continued on page 66

Ask Kaboom

Your Tech Answer Man

Michael J. Geier
c/o 73 Magazine
70 Route 202 North
Peterborough, NH 03458

More Amplifiers

Last time, we were discussing the buying and setting up of an HF linear amplifier. Let's continue:

OK, so you picked one and bought it! If it's new, you're substantially poorer but plenty happy, because you can be pretty sure it'll work. If it's a used amp, either you've seen it work or, like me, you took a chance, hoping the seller was honest when he told you it was a wonderfully operating bargain. Let's find out!

Hook It Up

Connecting an amplifier to your radio can be simple, but it isn't always. Sometimes there are obstacles. For starters, where do you put the big beast? I recommend that you don't put it right up against the radio. Why? Two reasons: heat and RF feedback. Amps really get quite warm in operation, especially if you use them in some continuous-duty-cycle mode like RTTY or SSTV. Do you want all that heat going into your radio? Aside from possibly shortening the rig's life, the extra heat may very well cause the radio to drift noticeably, even if it's a modern, digitally synthesized model. The reference oscillator, although crystal-controlled, can drift thermally enough to cause the radio to slide a bit. Heck, some smaller HF rigs drift a little from their own final amps' heat!

The second issue is more immediate. No matter how well grounded your station is, that amp will throw some RF, and it can glitch your rig something fierce, causing everything from screaming audio feedback to "permanent keying"; you may have to turn the radio or the amp off to get it out of transmit! Besides, if your station is like most, it probably doesn't have an ideal ground, exacerbating the situation. There are two things you can do, besides getting a really good ground, to help avoid the RF feedback blues. First, keep the amp a good foot or more from the radio. Second, line up the equipment so that the antenna lead goes from the radio, to the amp and out the window without crossing back near the radio. In other words, put the boxes in a line, from rig to amp to window. In some marginal grounding situations, like the one I used to have when I lived up in Vermont, that can really make a difference. I remember that, when I tried it the other way, with the amp's output coax going back behind the radio, it went nuts. When I put it all in a line, it worked fine. Hey, it even rhymes!

> ***"You may've heard horror stories of people having to use tuners between solid-state radios and older amplifiers."***

Wire It Up

Now that you've selected your operating layout, it's time to connect it all up. Obviously, the radio's antenna coax goes to the input of the amp, and the antenna goes to its output. If you have an antenna tuner rated for less power than your amp puts out, ***don't*** put it at the output of the amp, even if you intend to leave it in the bypass position; chances are, you'll fry it when you tune up the amp. The switches and connectors in small tuners aren't intended for such service, and they may arc or melt down when you hit 'em with the juice. Until you've actually put out 500 or more watts of RF, you have no idea what it can do; it behaves very differently than when you run 100 watts. It's perfectly fine, though, to put the tuner between the radio and the amp's input, although actually using it with the amp turned on can complicate the tune-up procedure.

With older radios, you can usually connect the relay output directly to the relay on the amp. With newer sets, though, there may not be enough current to drive the amp's relay without damaging your radio! That's especially true when you use a newer radio with an older amp, as many of us do. There are several ways out of this predicament. First, if your radio's manufacturer offers a relay box, you can simply buy it. Or, you can make your own. To do that, see my article entitled "Key It" in this issue, or design your own relay circuit, always keeping in mind the current limits of your radio, which should be stated in the manual.

If your amp has an ALC input, connect your radio's ALC output to it, using a shielded cable. Usually, the ALC output is present on an accessory connector, somewhere near the relay output. A good audio cable will do fine here. Do you really need to use ALC? No, but it sure helps you avoid splattering all over the band, which is quite easy to do with an amp, particularly if your radio is, like most, lacking an RF power output control for SSB. If you're depending on the rig's microphone gain control to keep things under the drive limit, you're pushing your luck. If, though, either your radio or amp has no ALC connection, you can still use them with each other. Just be careful not to overdrive the amp, or you may have to look for that little pink slip in your mailbox, or, at least, accept the wrath of all those people on the band who don't appreciate being splattered on from 20 kHz away!

Most amps and radios use negative-going ALC which ranges from zero to about -5 volts DC. Usually, you can just connect the cable and go. Some, though, use an oddball arrangement, with positive voltage or another voltage range. If you can't get your amplifier to put anything out, try disconnecting the ALC line. If that brings it back to normal, you either have an incompatible setup (in which case you'll have to run without ALC), or your amp may have an ALC adjustment you need to do to get it working properly. If that's the case, follow the manufacturer's instructions. If you don't have them, turn the amp's ALC pot wide open, tune the amp into a dummy load with the rig sending a carrier at full output power (as long as it doesn't exceed the amp's limits) and then turn the pot down until the output just starts to fall. That ought to do it. Just remember to do all this quickly, because very few amps can stand putting out full steady-state power for very long.

Don't forget the ground! With all that RF floating around, proper grounding is even more important than it is with a lower-power setup. Most of my problems with amplifier operation have been due to poor grounding, which causes horrendous RF feedback, essentially wiping the rig out so badly that it's useless. The best arrangement is a "star" ground, in which the rig's and amp's ground terminals are connected with braid to a common ground point, preferably an outside rod. Although a "serial" ground, in which the braid goes from the rig to the amp and then to the ground, can work, it can also cause RF feedback, so it is not a great idea. And ***never*** run the braid from the amp to the rig and then to ground—that's just asking for lots of RF energy to get pumped back into the radio.

Rock and Roll!

You should be ready to give it all a try! If you're lucky, you can just feed carrier into the amplifier, tune it up quickly for maximum output consistent with a plate current dip, and yack away. If it doesn't work properly, though, there are some things you can try.

Before we go on, there's something I must say: Please, please exercise extreme caution when opening your amplifier or working near its antenna. ***Never*** open the amp with the power plugged in, and always discharge the anodes to the chassis before you go near them. The high voltages inside an amp will easily kill you, and so will the amp's RF output. It has happened to a few pretty experienced hams who got careless and ignored the rules. Nothing in this hobby

is worth dying for! With that in mind, let's take a look.

I Get Zip

No output? If you don't hear the amp's relay pulling in when you key the microphone, something's wrong with your relay circuit. Check it out. If you do hear the relay but don't get any output, try disconnecting the ALC line, as I mentioned above. If it still doesn't work, something may be wrong with your amplifier. First, is the radio putting power into the amp? If you see very little power going in, even though you've got the rig set for full carrier output, chances are a problem in the amp is keeping the SWR at the radio so high that the rig is backing off its power to protect the final transistors. An SWR meter between the rig and the amp will tell you the story. Don't expect 1:1 SWR. But, if it's more than about 2:1 and it never dips as you tune the amp, something's wrong.

"...we're gonna be up here all day!"

You may've heard horror stories of people having to use tuners between solid-state radios and older amplifiers. It is true that many older amps don't have tuned input circuits (not all newer ones have them either), but they should still exhibit an input somewhere near 50 ohms, unless there's a problem. My amp has no impedance matching network (there is one indicated on the schematic, but a look inside the amp reveals a direct connection to the tubes' inputs via a capacitor), and its SWR is about 1.4:1. So, what could cause the impedance of an amp to change so much that it would make the radio back off?

Usually, bad tubes. Where do you think the 100 watts you put into your amp goes? If it all stayed in the amplifier, those tubes would melt down! Some of that power goes out the antenna, along with the amplified signal. When the tubes don't emit sufficiently, the path through the tube presents a much higher impedance, making the amp's input impedance rise quite a bit—the signal has nowhere to go. When I got my amp, the tubes were DOA, except for the filaments, and the SWR was about 5:1. Ouch! A working set of tubes reduced the SWR to its perfectly acceptable 1.4:1.

Another place to look is the antenna relay. Thanks to all that RF power flowing through them, the relay contacts can really get crudded up. Both of the amps I've owned have required relay cleaning, using a burnishing tool. No contact, no signal.

If you do get some output, but not nearly enough, chances are your tubes are weak. Unlike transistors, tubes can work at various levels of performance. Again, look for raised input SWR. Also, check that the filaments light on all the tubes! Multiple-tubed amps run the tubes in parallel, and will still work at reduced performance even if one or more of them is as dead as the proverbial doornail. Like the old saying goes, "If that last engine goes out, we're gonna be up here all day!"

Finally, if you're sure the tubes are good, set the amp's meter to its plate voltage scale, key the amp with no signal input and see that the high-voltage power supply is working. Don't be alarmed if the reading is as much as a couple of hundred volts off from the specified value; not only are those meters not very accurate, but the exact high voltage will depend on your AC power's voltage, which can vary enough, from region to region and even by time of day, to cause a significant change in the high voltage reading. Remember, the high voltage is multiplied from the incoming AC. So, if your plate voltage is supposed to be 2500 volts, and the amp is running on 120 volts, that's a step-up factor of about 21. If the incoming power drops by, say, 10 volts, that's a 210-volt difference in your reading. Still, if your expected 2500 volts reads 900 volts, the high voltage supply isn't working properly, and may have a bad diode or other failure.

Well, that ought to do it! You should be on the air, loud as can be, with a nice, clean signal. Until next time, 73 from KB1UM.

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119

Bullet-Proof Your Valuable VHF Microwave Converter.

Well, this is the time for all jollity and merriment as Christmas approaches. I hope you and yours are all enjoying the holiday seasons. Here in California, "seasons" are usually defined by two, the rainy season and the sunny season. In the summer it's *too* hot, and in the winter it's somewhat rainy. This year the rainy season lasted unusually longer into a normally dry month of July. I envy others that are able to enjoy four seasons. Have a merry Christmas and a happy New Year.

This month I want to reflect on several aspects of making your project VHF/UHF converters resistant to destruction, or, "Make It Bullet-Proof." What I mean is having a construction technique that embeds some safety measures in it's design to allow a margin of error, or happenstance factor. Having this factor built into, say, a microwave converter will give a you some very valuable protection to your mixer circuitry. This one device seems to take the brunt of punishment from a converter standpoint. The mixer is the one device that interfaces directly with the IF system of a two meter or other transceiver and could be keyed directly into by the transceiver when an IF switching circuit malfunctions. The effort here is not to make the simplest system that will function, but one to which some protection circuitry is added to protect your equipment as much as possible.

We all have used the breadboard construction technique to experiment with different circuits of interest. This method is time proven but has several drawbacks, especially when we go to place the bench-tested breadboard circuit into operation with a quick "wanna see it work" attitude. This is not a problem for a quick test, but further cleanup of circuitry and housing problems remain that must be dealt with before the circuitry can be called reliable. It may test just fine on the bench, but when connections and cables are moved about there will be lots of intermittents and other disparaging problems. We need to increase the circuit's "survivability."

Not to worry. What you are seeing is the birth of a finished product. It does not have to have a machine-milled cabinet with inlaid labeling. All it has to have is a reinforced back plate for connections and some type of metal enclosure to shield the respective circuitry contained inside. What comes to mind, in the simplest form, is the use an aluminum chassis upside down to mount all components internal to the chassis. Construction is usually limited to minimum holes drilled in the chassis to mount parts and circuit boards. The back board cable entry is especially nice in comparison to loose clip leads and other cables run about the test workbench. This pile of spaghetti has become tangled and even set the stage for a set of trip wires that have sent parts flying. It has happened to me and only cleaning up our act improves this operation. Now that our house is in order, let's get on to the meat and potatoes of this month's column.

Construction of a microwave converter, while not intended to be expensive, does contain some hard-to-locate components. These can be modified devices and home-constructed amplifiers; however, one component still eludes our grasp for home modification or construction: the microwave mixer. Suitable mixers have been constructed for the lower microwave frequencies, but for a 10-GHz mixer, this one item, the commercial mixer, is considered "Rarium" or, as I usually say, "Unobtainium." Well, they are obtainable but very precious. This circuit I am about to describe is designed to protect them from key up power transients from the IF source a two meter radio.

As you know, the mixer only needs about 10 dBm of power to function properly from the IF device (usually a 2 meter radio), while the 2 meter radio is capable of powers far in excess of 10 dBm. Most HTs will provide 2 to 5 watts of power while other rigs are in the 10-watt class. The problem is that, in receive, the mixer circuitry needs to be connected as direct as possible without attenuation to the receiver circuits of the 2 meter radio for best receive performance. While in transmit, the output power of the 2 meter radio may be operating at reduced, low-power ranges. It still needs to be attenuated down to the +10-dBm range to prevent mixer burnout.

The worst scenario possible, even after taking care of proper relay-switching circuitry, is to have the relay fail to operate, and having the low-power (usually 1/2 to 2 watts) key full into the mixer. See Figure 1 for a basic switching circuit. Note that if the relay fails to operate, the full RF output of the IF radio is applied to the mixer. This is usually always "fatal" to a mixer, and we term it rear-end mixer blowout. Now, when this is your precious, one-of-a-kind mixer, what can be done to prevent your mixer from being toasted from excessive RF?

The North Texas Microwave Society a few years ago came up with quite a clever protection scheme—a circuit improvement to the scenario shown in Figure 1. They placed an amplifier and attenuator in the receive path, effectively blocking high-power RF from a direct connection between the mixer and the 2 meter radio. A single Microwave Miniature Integrated Circuit (MMIC) amplifier like a MAR-1 is used for the amplifier. It has about 10 dB of gain and is followed by a 10 dB-attenuator making the entire circuit *zero gain*. That is, the gain of the amplifier is offset by the loss in the attenuator pad.

If for some reason the switching relay fails to operate, and the transmitter is keyed into the receive path of the mixer circuit with this configuration in place (Figure 2), two things happen. First, the power of the transmitter is attenuated by the receiver amp output attenuator, reducing power through the pad. Second, this reduced power from the 2 meter IF radio is applied to the output circuitry of the MAR-1 MMIC amplifier, further reducing power through the MMIC (backwards) to the input circuit of the MMIC amplifier and on to the mixer.

Bench tests show that, even when 10 watts were applied to the circuit to test for immunity to high-power RF, the above circuit did not fail. As predicted the power was attenuated by the attenuator and the MMIC survived this high-power surge.

This excessive power was not kept on for a long test period as the 10-dB pad which was constructed out of 1-watt resistors, would not have stand a long transmitter key up. They will take abuse for a few minutes or less, easily. It is hoped that you have quickly recognized your switching problem due to your station's

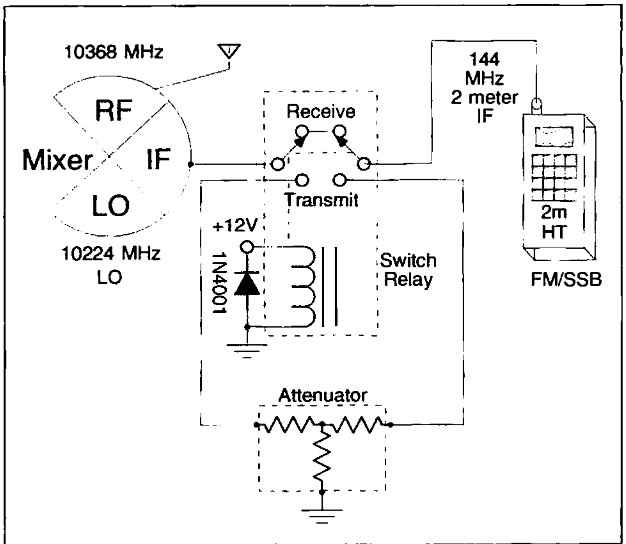


Figure 1. Standard IF switching circuit without protection, showing direct connection from mixer to IF 2 meter radio. On transmit, the switch operates by placing the attenuator in the path between the 2 meter radio transmitter and mixer.

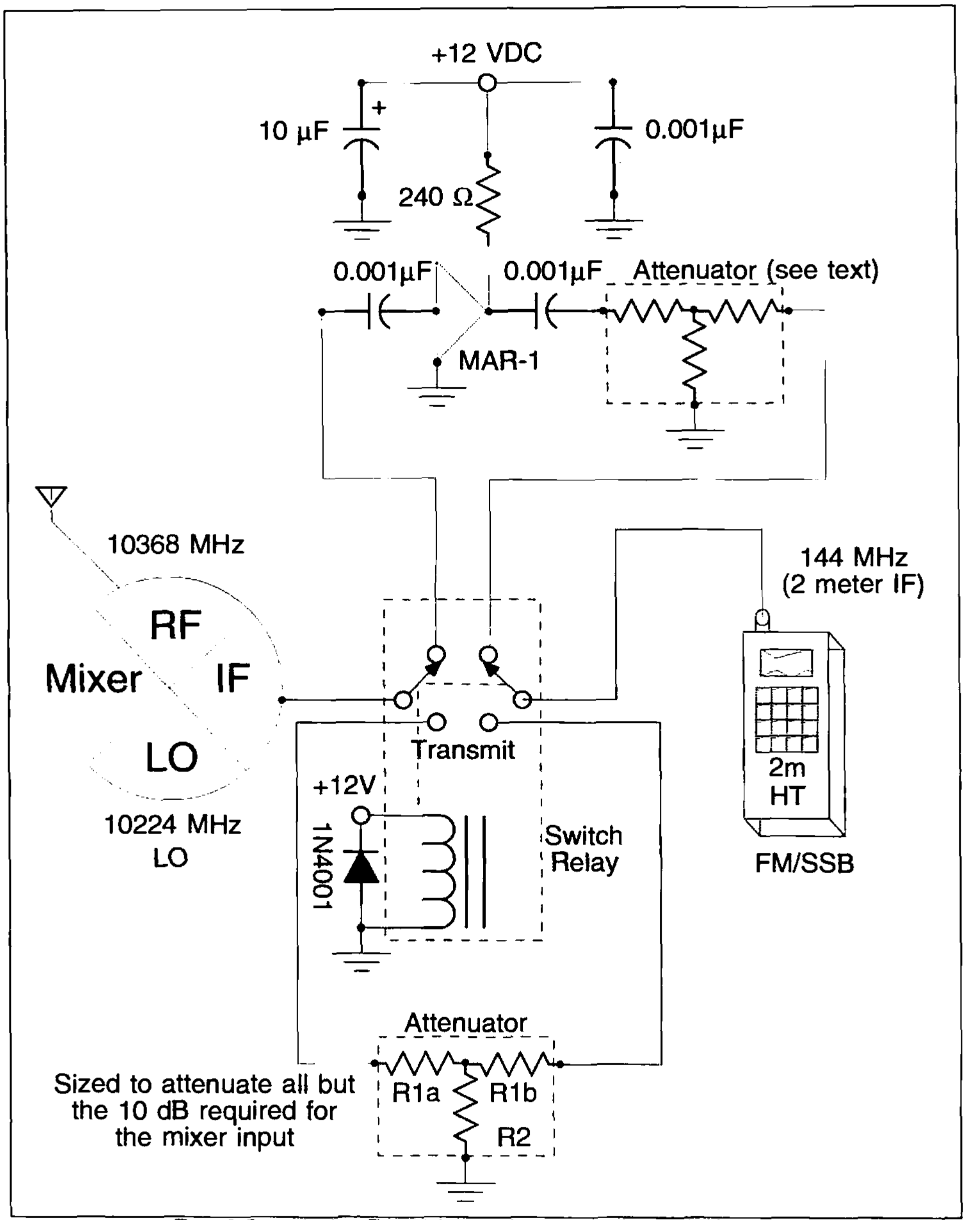


Figure 2. Same circuit as Figure 1, but note the protection circuit added for protection of the mixer from failure of the switching circuit.

the pad resistors can handle this on a continuous basis. Don't skimp here, as using an underrated pad is just as dangerous as the receiving switching key up troubles. I suggest for high-power pads that you look for commercial heatsinked high-power surplus pads rather than constructing them. Don't get me wrong—home constructed pads can work, but assembling a 10-watt non inductive 150-MHz pad is a little tough.

They can be constructed out of multiple 2-watt high-value resistors, whose combination paralleled value equals the desired single resistor value needed. The lower value required in the "T" pad attenuator arms make this the better selection for home construction and higher power pads. See Figure 3 for resistor values used to construct an attenuator that would withstand several watts of RF power.

Let's discuss the construction of a 20-dB attenuator as per Figure 3. From a formula for a "T" type pad with 50-ohms input and output impedance, the arm resistance (2 each) would be 41 ohms and the shunt resistor would be 10 ohms. Note that each of the input and outputs read 50 ohms in reference to ground and the respective input.

These values are not standard, and if we construct them using standard carbon resistors we can arrive at 40 ohms by paralleling four 160-ohm resistors. For the 10-ohm resistor four 39-ohm resistors are used. A pad or attenuator so constructed from eight 160-ohm carbon resistors and four 39-ohm resistors would yield an attenuation of 20.093 dB. So you see, by being slightly off the mark, the total value required is not real critical.

The wattage of the carbon resistors is a selection choice you have to make. If high powers are anticipated use 2-watt resistors for the attenuator. Reduce the resistors' wattage as you see fit, to include 2-, 1-, or 1/2-watt carbon resistors. If the pad is constructed from groups of four 1/2-watt carbon resistors, then the total pad should be capable of handling 2 watts of power. The same goes for pads similarly constructed out of 1-watt resistors equaling 4 watts of power, and, for 2-watt resistors so assembled, 8 watts of power handling should be feasible.

failure to transmit, and have begun to investigate.

The protection circuit, at worst, will destroy the pad or attenuator and not the mixer. This should happen only on very long key ups. Normal operations preclude the long key ups except for beam heading alignment, where transmitters are put on the air for several minutes at full power. Normally contacts are quite short and the circuit can survive many such short, attempted contacts. The best part of this circuit is that the remedy is quite inexpensive, compared to a new mixer.

"Just verify these parameters and fixes can be built into the system."

The MAR-1, or similar MMIC, costs in the $1 range, and the output receive attenuator can be made up from 1/2- to 1-watt resistors with several resistors paralleled to make the specific pad value required. By using several resistors, the power handling capability is increased to several watts continuous. It will stand the full 10 watts for a short interval. Resistor pad values will have to be adjusted to suit your requirements. The 10-dB pad is used with a reduced power driving source of 100 mW. If your IF power is higher, the pad value will have to be increased accordingly. For 10-watt rigs operating on full power, you will need a pad loss of 30 dB.

Most mixers require driving RF power of about +10 dBm, so with 10 watts (10 watts in dBm = 40 dBm), a 30 dB pad or attenuator is just right. When using pads for this power level make sure that

I can't stress this fact enough. These resistors should be carbon-composition types to prevent unwanted reactances that come from non-RF-type resistors, like wire-wound types. They exhibit an RF inductance to the circuit and should not be used. As a matter of fact, some small value types could be used for small value RF chokes. Use the carbon-composition types and all will be just fine.

Another type of mixer trouble may not be related to RF driving power and switching circuits. In deference to "rear-end mixer problems" this one could be titled "front-end mixer destruction." Front-end mixer troubles are the same product of overloading the mixer with input powers (excess RF level) of sufficient magnitude that it over dissipates the mixer with RF and destroys the mixer. This scenario is the same as previously described before, but now applies to a mixer that seemingly is protected by the RF preamplifier and does not utilize any switching circuitry. What then is going on?

What is happening is that the RF preamplifier used in applications like this are stacked, or are capable of significant gain, say, in the 30 dB or so gain ranges. Because of this high gain the amplifier might be capable of high output RF power like a transmitting RF amplifier. This condition can happen when the receiving preamplifier is subjected to very high input power levels approaching saturation. These levels are easy to create when multiple stations are operating on the same hilltop near each other. Just imagine the input power that a receiving preamplifier is subjected to when, out in the field, you turn your dish antenna towards another amateur's dish when he is transmitting. Not a good thing to try. I blew up a very low noise single-stage amplifier doing just that.

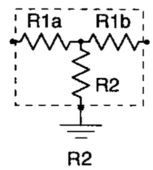
The other problem that could happen, when using a very high gain amplification string amp, or a converted multiple-stage amplifier, is that it will amplify its heart out and give you maximum gain before it goes into saturation (if it survives). The point to consider about protection to the front end of the mixer is, What maximum power output capability does the receiving preamplifier string have when operating under saturation RF input conditions? Most small signal devices will not make good high-power output amplifiers and usually saturate before zero to +4 or so dBm is reached. This is well within the safety range of a mixer's performance acceptance parameters. The maximum is typical to the LO power which is near +10 dBm for most mixers.

Failure to check this one parameter could yield you some surprise. One of our microwave group members *did* blow up a mixer in just the manner described here. It was a choice mixer. It was destroyed because the receiving preamplifier string was capable of providing +20-dBm output (that's 100 mW) when the input circuit was driven into saturation. Imagine a preamp putting out 100 mW. That's a nice transmitting amplifier, but for the poor mixer that's twice the maximum RF driving power and almost certain to over dissipate the signal diodes in the mixer forever.

Prevention of this scenario is simple: test the amplifier strings that are to be used together before connection to pertinent systems. Know what the capabilities are even in modes of operation that you don't expect to use. Just verify these parameters and fixes can be built into the system.

What is the fix for an overpowerful RF preamplifier with too much gain and high-power output? An example of this type of amplifier would be a CATV satellite LNA amplifier, or similar for other frequencies. These amplifiers have very high gains needed for satellite work, and while they are convertible to amateur bands and other services, we need to watch out for applications where the excessive satellite gains used for terrestrial use might be detrimental. In any case the fix is simple; connect a 10-dB attenuator if you experience high-power outputs. This will reduce that excessive power from the 100 mW power to a comfortable +10 dBm power level that is safe for the mixer. The extra gain in the amplifier was soaked up in the attenuator, but with "extra" gain you had some to spare, and I feel sure it will not be missed with the benefits derived from the mixer protection circuitry.

Attenuator



Attenuation	R1	R2	Combinations R1	Combinations R2
10 dB	26 Ω	35 Ω	2 each 51 Ω	2 each 75 Ω
20 dB	41 Ω	10 Ω	4 each 160 Ω	4 each 39 Ω
30 dB	47 Ω	3.2 Ω	4 each 180 Ω	4 each 13 Ω

Notes:

(1) Tie multiple resistors in series or parallel to obtain non-standard resistance values.

(2) Use only carbon composition resistors to avoid RF reactances.

(3) Use 1/2, 1, or 2 watt resistors as required for your power needs.

Figure 3. Attenuator values for possible loss calculations to attenuate RF power of transmitter and receiver protection circuit.

Well that's it for this month. I hope you and yours have a Merry Christmas and a Happy New Year. 73 Chuck WB6IGP

Number 58 on your Feedback card

HAMS WITH CLASS

Hands On For Fun!

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Switches and Fuses

New term; new kids; new ideas; and of course old problems. Every year it seems that we who are on the front lines with young students must keep coming up with new ways to get their attention, and new techniques to test that they have indeed learned the material. The teacher of ham radio in the classroom, fortunately, has many tried and true experiments and demos at his or her disposal to help get the concepts across.

I'm always looking for new hands-on projects to do in the classroom, but there are some simple ones that I use every term because they are effective and the kids really like them. The following two projects can be adapted to any group in grades 4 through 8. Every child in the class should be able to participate on some level; or it can be done at home for extra credit.

The book *Inquire* by Educational Service, Inc. has a good lesson for "Making An Electrical Switch."

Purpose: To make an electrical switch and show that it works on the same principle as the electrical light switch.

Materials: Three lengths of light insulated wire (one piece 11 inches long and two pieces 20 inches long), an 8 x 8 inch board (2 inches thick), a 20-watt light bulb, a light socket to fit the light bulb, #6 dry cell battery with terminals, wire cutters, 2 popsicle sticks, a hammer, and three nails.

Procedure: Take 6 inches of the insulation off one end of both of the 20-inch-long pieces of wire and 2 inches off the other two ends. Also take 2 inches of insulation off of both ends of the 11-inch piece of wire. Wind the 6 inches of uninsulated wire around one end of the popsicle stick, one wire on each stick. Nail both ends of one stick firmly to the board. Nail only the wireless end of the other stick to the board (do not nail down firmly) so you can turn the popsicle stick. Attach one end of the 11-inch wire to a light socket terminal and one end to a battery terminal. Attach the free end of the movable popsicle stick to the other light socket terminal. Then, attach the free end of the stationary popsicle stick to the other light socket terminal. Insert the light bulb into the socket. Turn the movable popsicle stick so its uninsulated wire touches the uninsulated wire of the stationary popsicle stick completing the circuit and lighting the light bulb.

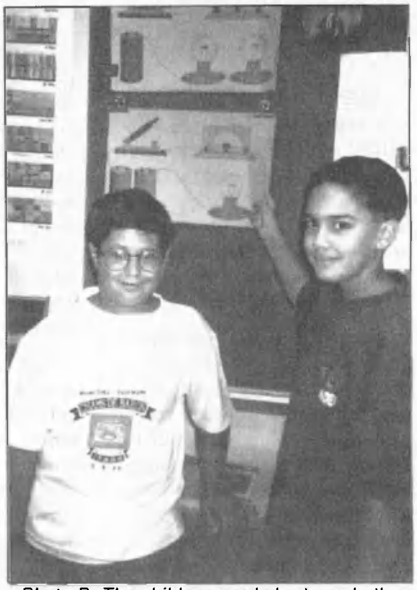


Photo B. The children used charts and other instructional aids to demonstrate their circuits. That's Vinny (7th grade) on the left, and Joe (6th grade) on the right.

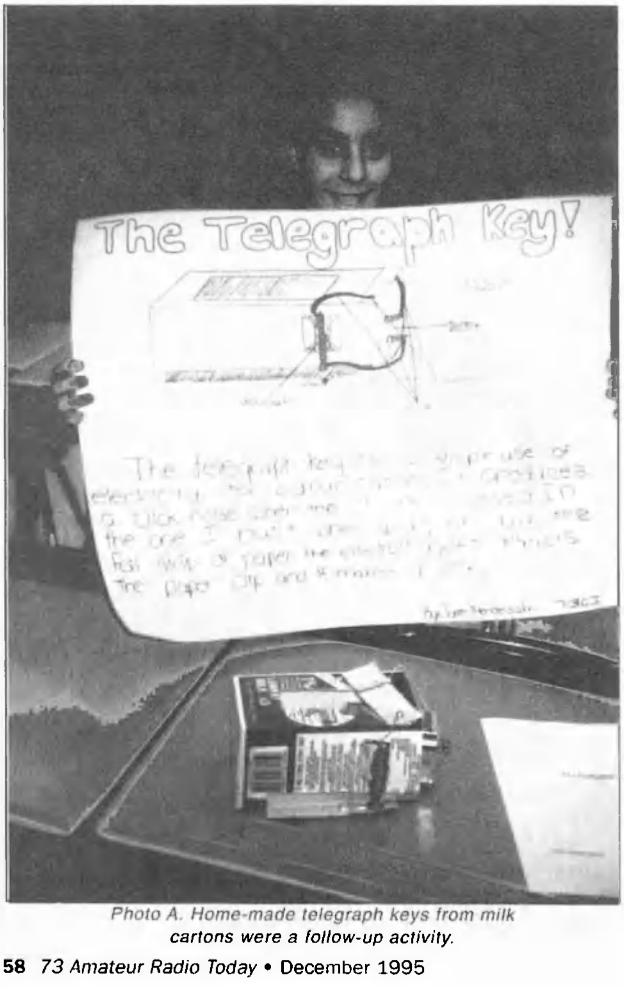


Photo A. Home-made telegraph keys from milk cartons were a follow-up activity.

Variation: Divide the class into groups. Duplicate the directions for making a switch and have each group make an electrical switch as a project. The groups will know if they followed directions correctly if the light bulb lights up.

When your students have mastered the skills you require from the above project, let them try this next one at home and then show and tell the rest of the class their results. "How Does A Fuse Work" is a natural follow-up activity.

Purpose: To learn how a fuse works.

Materials: The switch used in the above activity, and a piece of thin tin foil.

Introduction to the class: "Today we're going to learn how a fuse works. Then we will make one for ourselves. An electric fuse is a protective device for the electrical system. The fuse is a soft metal, with one point having a lower melting point, enclosed inside a fireproof container. When there is a problem inside the electrical system, such as, a short circuit or too many appliances operating at the same time, the fuse will melt or blow, breaking the circuit. This blown fuse indicates that something is wrong with the circuit and should be corrected. In the case of a short circuit, the short should be located and repaired. What should be done if the fuse blows because too many appliances are operating at one time?"

Procedure: Disconnect the light socket and insert in its place a piece of thin tin foil. We now have our fuse. Let's see what happens when a fuse blows (melts). I will turn the switch to complete the path of the electrical circuit. What happened class? Correct, the thin tin foil gets warm and melts, breaking the electrical circuit. What happens when a fuse blows at home, school?

Some of my groups made excellent charts and posters showing their work. When they made their presentation to the class they were well prepared with visual aids and lots of "teacher tools" to make their points more clear. 73

Number 60 on your Feedback card

CARR'S CORNER

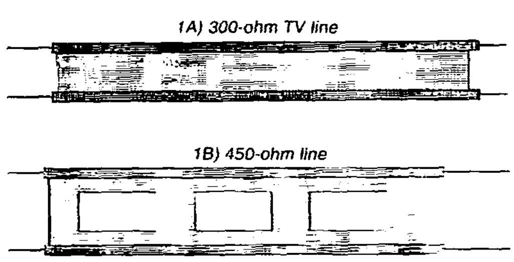
Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church, VA 22041

Some Ham Antennas Made From TV Twin-Lead

Twin-lead transmission line (Figure 1) is generally quite cheap, and can be used to make a variety of different antenna types . . . as well as being used to carry signals back and forth between the rig and the antenna.

Figure 1 shows two popular varieties of twin-lead transmission line. The variety of twin-lead shown in Figure 1A is 300-ohm television antenna transmission line. TV-style twin-lead has small diameter copper conductors separated by a rubber or plastic insulating material, all molded into one piece. This type of line is quite light for transmitter use, but will easily handle power levels up to a couple hundred watts. I know only one person who routinely used 300-ohm twin-lead on a kilowatt rig, and he claimed it ran uncomfortably hot to the touch!

A thicker, wider, and tougher form of twin-lead is the 450-ohm stuff shown in Figure 1B. This line usually has square holes cut into the plastic insulator separating the conductors in order to reduce losses. The 450-ohm line can be used at higher power levels than the 300-ohm line, and is a reasonable replacement for a 600-ohm parallel, "open-air," transmission line called for by some antenna designs.



Figures 1A & 1B. Twin-lead line

The "Quick 'n' Dirty" Twin-Lead Antenna

The antenna shown in Figure 2 is one of the first that I ever used (when a mentor, W4II, gave me a roll of twin-lead wire), after seeing it in an early edition of Bill Orr's (W6SAI) *Radio Handbook*. I ran this type of antenna out a basement window, and attached the top end to an old pine tree, and the middle supported by a 2X4 nailed rather unceremoniously to a tool shed on the back of the house.

Basically a quarter-wavelength "Round Robin" Marconi, it consists of 300-ohm or 450-ohm twin-lead transmission line with a length of $234/F_{MHz}$. Thus, for 40-meters the length would be about 32 feet 6 inches long overall. The 52-ohm coaxial cable is connected such that the center conductor goes to one conductor of the twin-lead, and the shield goes to the other. If you desire, ground the shield of the coax, as well as attaching it to the twin-lead.

The "Quick 'n' Dirty" (or "Round Robin" as my mentor called it) can be installed at an angle (as shown), although I suspect best performance occurs when the wire is straight. In the version that I had, there was only a small VSWR with one bend that put the vertical and horizontal segments at about a 120-degree angle.

This antenna works better than single conductor Marconi antennas because regular Marconis suffer from ground

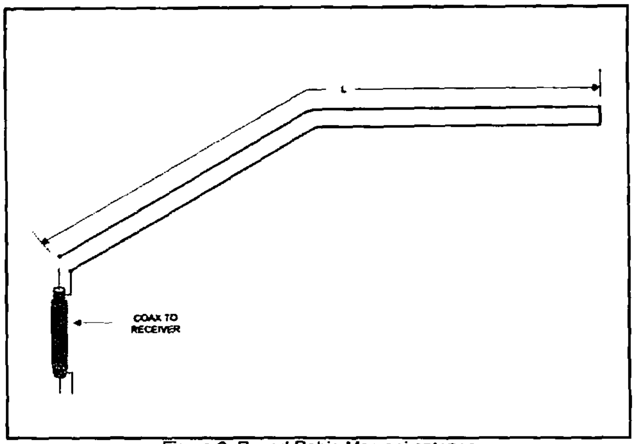


Figure 2. Round Robin Marconi antenna.

losses. By supplying a return line, the radiation resistance is raised from 10 or 15 ohms, to something on the order of 40 to 50 ohms—which makes it a good match to 52-ohm coaxial cable.

Folded Dipole

The folded dipole (Figure 3) is one of the most popular twin-lead antennas. It's a half-wavelength dipole made of twin-lead. Note that the parallel conductors at the ends of the antenna are tied together (and soldered, by the way). The feedline is connected to the folded dipole in the center of one of the conductors. If 300-ohm twin-lead is used as the transmission line, then it can be connected directly to the radiator element. But if you want to use coaxial cable to feed the antenna (which is a heckuva lot more convenient), then use a 4:1 balun transformer between the coax and the antenna's feedpoint.

For low and moderate power operation, the folded dipole is a reasonable choice for hams. it has a bit more bandwidth than the straight dipole, so is easier to use without a lot of adjusting of the antenna tuner (especially with modern rigs that have a VSWR shut-down circuit). On the negative side, the typical folded dipole is somewhat less robust than the standard dipole. Unless special measures are taken, the folded dipole may very well come falling down in winds a bit more than a gentle breeze. Some of those special measures are discussed in detail in my book *Joe Carr's Receiving Antenna Handbook* (HighText Publications, Inc., P.O. Box 1489, Solana Beach, CA, 92075; $19.95). If you want to build a folded dipole, then I highly recommend that you review that material.

The azimuthal pattern of the folded dipole is a standard "figure-8," very nearly the same as for regular dipole antennas. In other words, it is bi-directional and transmits broadside to the wire; there are two nulls, one off each end of the wire.

Folded Dipole Beam Antennas

Over the years it became popular to make beam antennas from folded dipole antennas. A well-designed, properly installed two-element directional antenna refocuses the figure-8 pattern of the half-wavelength dipole or folded dipole into a single direction, resulting in a gain of about 3 dB (ideally). A 3-dB gain is equivalent to doubling your transmitter power. The actual gain will be somewhat less, in most cases, because of installation or design difficulties.

The antenna shown in Figure 4 uses two folded dipoles, installed parallel to each other about one-eighth wavelength (l/8) apart. One folded dipole acts as a reflector and the other as a driven element. Which is which can be

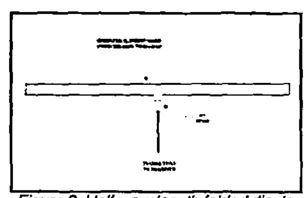


Figure 3. Half wavelength folded dipole.

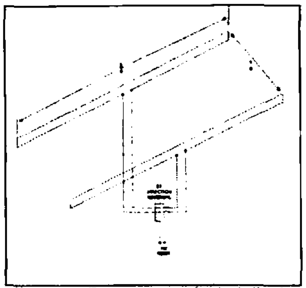


Figure 4. Two-element folded dipole beam features reversible directivity.

changed by using a double-pole, double-throw (DPDT) switch at the point where the two feedlines come together. This switch must be heavy duty, even for moderate power levels. I've seen a large light switch used in this manner. A pair of "three-way" AC power switches, ganged with a brass rod to make their toggles work together, can be used.

So why do you want to change which is the reflector and which is the director? It's simple: this antenna is bi-directional, but only one direction at a time. The antenna transmits in the direction of the one that is excited, with the other element acting as a parasitic reflector. Reversing the roles of the elements reverses the direction. In an ideal beam, the reflector would be a tad longer than the driven element, but in this case they are the same length which results in a bit of deterioration.

It is very important on this antenna to make the two feedlines exactly the same length, even if it means wasting a bit of wire on one of them. If you want to feed this antenna with coaxial cable, then the 4:1 balun transformer can be placed at the common terminals of the DPDT switch.

An old favorite with the twin-lead crowd is the ZL-special shown in Figure 5. This antenna is very much like Figure 4, except that the two folded dipoles are connected together with a phasing harness made of 300-ohm twin-lead. Spacing is about l/8 to l/4,

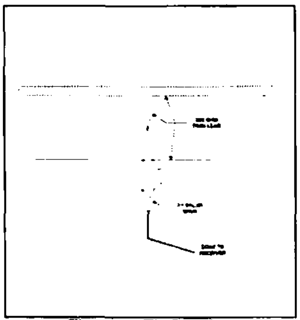


Figure 5. ZL-Special.

while the most usual prescription for the phasing harness is to make it either l/4 or 3l/8 long. Keep in mind that the electrical length is shorter than the physical length by the amount of the velocity factor of the line. If you want to make a l/4 phasing harness with line that has a velocity factor of 0.80, then the physical length would be:

$$246V/F_{MHz} = (246 \times 0.80)/F_{MHz} = 197/F_{MHz}.$$

Contacting Me

If you don't hear my elderly TS-430 barking out CW on 40-meters or 20-meters, or occasionally SSB on 15-meters, then try writing to me at P.O. Box 1099, Falls Church, VA 22041. Or, if you are a cyberspace surfer, then contact me via E-mail at carrjj@aol.com. 73

QRP

Number 64 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

There's nothing quite like spending quality time working on a few simple circuits. You generally can get a hefty helping of the warm fuzzies when even the simplest circuit functions as planned.

So, let's take a look at several simple circuits you can build. Some are modifications to commercial rigs, others are standalone projects.

This month, I've also started something different. Since many of the best circuits are simple, there's usually no PC board. "Just use perf-board" is the battle cry we hear all the time. Well, I've been working on this long-time problem from my end. Starting with last month's RIT for the Small Wonder Labs rigs, I've laid out the schematics using a PC board CAD program called "CIRCAD," which has the ability to generate a "net list" after the schematic has been laid out. By using this net list feature, it is possible to lay out a PC board and be fairly sure it will work. Provided the schematic is correct that is! The PC board will only be as accurate as the schematic. I've found it hard to change from my old way of making PC boards. First, I build a prototype board, make corrections, make another set of PC boards, make corrections, and so on until the finished PC board is accurate. Needless to say, that takes a lot of time and money. By using CIRCAD, you generate the schematic, import the net list, autoroute the board and you're done.

There is also another added feature. I will upload all the files in a PKZIPped format to both CompuServe and America Online. The files will be in the HamNet SIG hiding within the QRP section library files. Use the key word "CIRCAD" to locate the files in the libraries.

On America Online, the files will be in the ham radio SIG. CIRCAD, while a commercial product retailing for about $1,000, is also available from both services, runs under DOS and requires at least 4 Meg RAM and a hard drive. CIRCAD will *not* run under windows. The demo version *does* work and will generate artwork. However, there is a limit on the number of ICs that can be used and it will not generate either the gerber or drill files. Other than that, the demo version will work just fine to "fine tune" any of these smaller projects. I'll have a complete review of CIRCAD coming next year. Look for it.

One last note about these PC boards. I do not have the free time required to build and try out each and every circuit. The PC boards "should" be error free. Keep the hate mail down to a minimum if the boards don't work as they should. However, if you find a mistake, by all means let me know and I will correct the files and replace them on the BBS. I would check and double-check any artwork before committing to a large run of PC boards. I'm sure you may need to tweak a few of my layouts to suit your needs or requirements.

The first circuit is a modification of last month's RIT by Dave Benson. As I mentioned last month, it would be rather easy to build on a RIT "on" LED to the circuit. Well that is exactly what I did. I also put on the PC board lots of pads to make connections to and from your transceiver as easy as possible. I added some decoupling capacitors to the VCC pin of the 4066 for good measure.

The schematic for the modified RIT is shown in Figure 1. The PC board I laid out is not as small as Dave's version. Instead of standing the resistors and diodes on end, they are laid down flat. There are no mounting holes—you can use double-sided foam tape or hot melt glue.

Here is one more add-on circuit for the popular MFJ QRP radios (Figure 2). This circuit watches the RIT voltage and will tell you if the RIT is active or not. This circuit comes from Paul Harden NA5N. Basically, the circuit consists of two op-amps (in a single 8-pin DIP package) which constantly monitors the RIT line. The circuit is designed for the MFJ mono-banders, but you may be able to find diverse uses for this project.

In a nutshell, one op-amp monitors the voltage generated by the RIT control when it is moved from its center position. When the RIT control is moved, the voltage across it changes. By comparing the RIT control voltage against the reference voltage generated by the two pots, the op-amps will switch states, lighting the LED. How tight you set the two reference pots will determine where in the RIT control the LED will light.

I have not given this circuit a try, but have used voltage comparators like this one for years. If you have trouble with noise or RF getting into the comparators, tack on a 0.1-μF capacitor at the junction of R3/R1 and the voltage reference pots.

To fancy things up a bit, instead of the junk box LED, how about using a bi-color LED instead? This way you can tell what direction the RIT is set. You will need to remove the two steering diodes and insert a current-limiting resistor in their place. Any value from 470 ohms to 2k ohms should be fine.

The basic circuit can easily be changed to provide a battery status indicator. Instead of feeding R2 with the RIT voltage from the MFJ rig, use a stable voltage reference source such as a LM336Z 5.0 diode. Again, remove the two diodes and in their place install a 1k-ohm resistor. By using two LEDs, you can set one comparator to give you a green OK for the

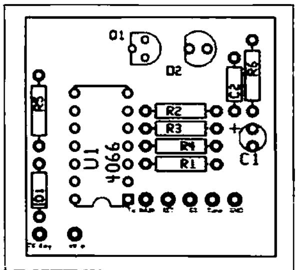


Figure 1a. Parts layout for the 4040 RIT.

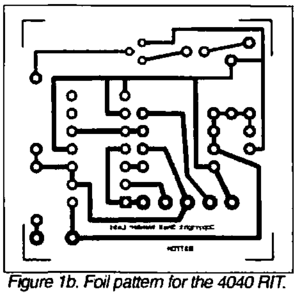


Figure 1b. Foil pattern for the 4040 RIT.

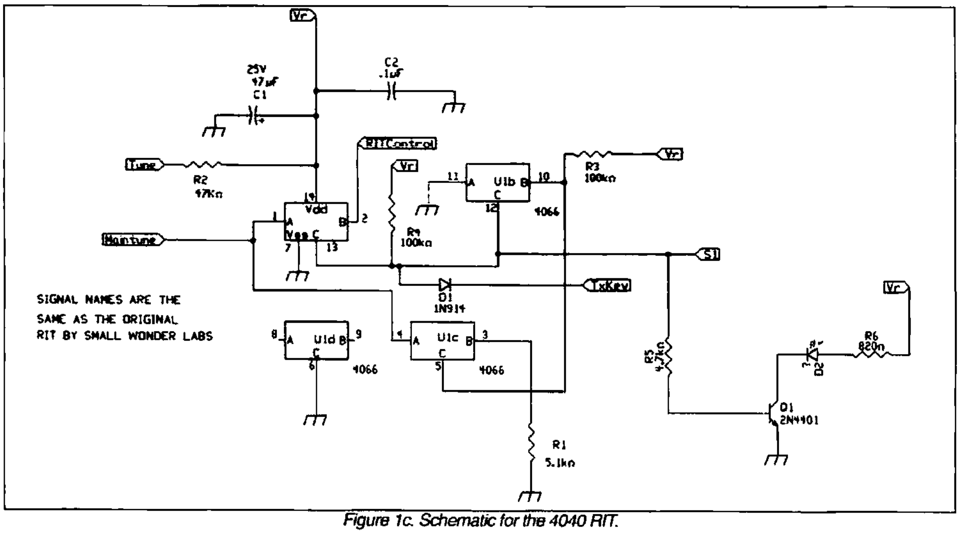


Figure 1c. Schematic for the 4040 RIT.

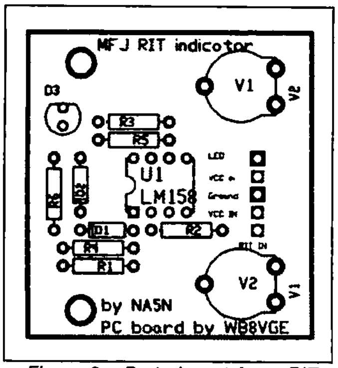


Figure 2a. Parts layout for a RIT voltage detector for MFJ QRP radios.

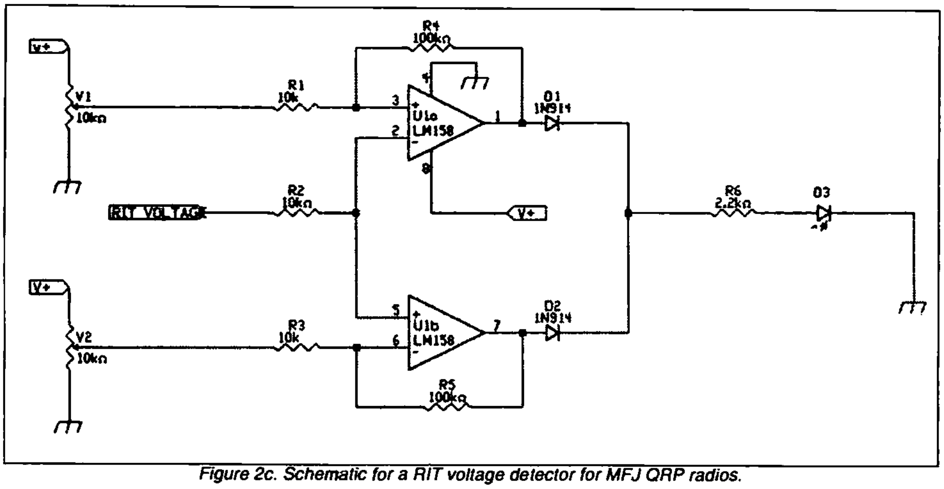


Figure 2c. Schematic for a RIT voltage detector for MFJ QRP radios.

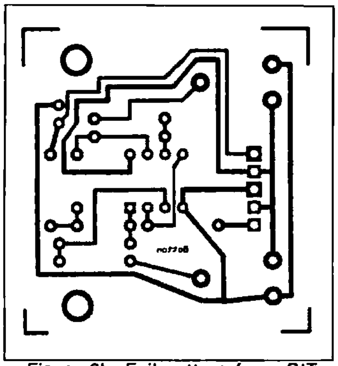


Figure 2b. Foil pattern for a RIT voltage detector for MFJ QRP radios.

battery. The other comparator will light a red LED when the battery voltage drops down. You select the voltage points by using the two pots. Although I laid the circuit out for single turn pots, you might want to put in 20-turn trimmers to make setting the reference voltages a bit easier. Also, by adding a resistor to the top and bottom of both pots, you can expand the voltage divider, making the setting of the reference points easier still, even when using the single-turn trimmers.

Although you would need an external op-amp to boost the output from a SWR bridge, you could easily adapt the circuit to warn you of an excessive SWR on your portable antenna. This really is an easy-to-use circuit and its use is limited only by your Imagination!

As I mentioned earlier, both the PC and the schematics will be uploaded to America Online and CompuServe. Both will be hiding within the ham radio SIGs. On CompuServe, the files will be in the QRP SIG library inside HamNet. Both files will be "zipped" to speed download times. You will need the demo version of CIRCAD to view or modify the files. CIRCAD is available on both systems.

I'm currently working on putting together some modifications to the Ten-Tec Century 21 series of rigs. There seems to be a rather big hole when it comes to modifications and fixes for this classic rig. Although not a QRP transceiver by any means, many a Century 21 has been put to use by QRPers. If you have any modifications for this rig, by all means send them to me.

HAM TO HAM

Continued from page 50

answered very authoritatively "Oh my gosh, no, you'll be insulating it from the air and it won't work!"

Even though we talk about getting on-the-air, and our signals radiating through the air, direct contact with the air isn't a factor in whether a particular antenna works well or not. When the astronauts were on the moon's surface, with no air anywhere except within their space suits, their radio signals made it back to earth in fine shape. The rubber ducky type of antennas seen on virtually every hand-held transceiver, though not in direct contact with the air, seem to do a pretty good job for the most part. In fact, I've painted several ham antennas using a flat lacquer-based spray paint without any regrets, only longer life from the antennas!

It's true that using insulated wire for a horizontal dipole will change the dipole's length requirements slightly, but it certainly won't prevent it form working just as well as a bare-wire antenna. Most people don't use insulated wire for wire dipoles simply because there's no point in paying for insulation that isn't really needed. A dipole is normally strung up high enough in the air to be out of reach of children and others, so insulating it from accidental human or animal contact isn't usually a factor. If it's not up high enough to be out of reach, I'd definitely opt for the safety factor of insulated wire!

But a thin coating of non-metallic paint on your 2-meter beam or vertical won't affect the resonant frequency to any appreciable degree and it certainly won't render it an ineffective radiator or receptor of RF energy. Just make sure that any metal to metal contact points aren't inadvertently insulated, and I'd stop short of getting any paint on the matching section—just in case it requires a minor change in tune-up—or on any insulating connection blocks to avoid possibly changing their insulating properties.

Before any painting, I would also make sure that the aluminum is thoroughly cleaned of any oil that might have been used during the machining process and that any shiny aluminum be lightly sanded to give better grip to the paint coating. Flat gray primer spray paint is usually a good choice for this type of situation since it's formulated for good adhesion on bare metal. And it's best to do all spray painting out-of-doors, in calm weather, for safety and health reasons.

A Word Of Caution In Using Spray Contact Cleaners Near RF Circuitry

Spray contact cleaners, those commonly sold to clean noisy switches and potentiometers, should be used with a great deal of caution around any parts carrying RF voltages and high RF voltages in particular. This would include using these sprays on any band-change rotary switches used in many of the older ham transceivers, linear amplifiers and the current lineup of manual antenna tuners.

Before the broad-band, no-tune final RF stages became commonplace in ham transceivers, most rigs used mechanical, multi-section rotary switches to accomplish all band-changing functions within the radio. The temptation to use ordinary spray contact cleaners on these switches, however, especially the sections carrying high voltage RF, should be strictly avoided.

Many of the popular spray cleaners will leave behind an oily deposit, used to lubricate the item being cleaned, but in RF circuits, this oily deposit can soak into the switch's insulating wafers, causing them to lose some of their non-conductive RF insulating properties. That oily surface will also cause dust and grime to collect on the insulator, further exacerbating the problem by gradually creating a semi-conductive surface on the insulating wafer. The final result can be arcing and eventual carbonization of the wafer material—particularly if it's of a phenolic base—with almost certain destruction of the switch—and perhaps other associated parts—in the end analysis.

The lesson to be learned here is to never use ordinary control-cleaning spray on RF circuit parts, particularly if that spray leaves behind an oily lubricating film. If RF switching sections absolutely must be cleaned, take the time to do it by hand, with a swab, using only small amounts of cleaning medium and then only a medium that will evaporate completely without leaving behind any left-over residue. In reality, rarely do these switches need any more cleaning other than simply being "exercised" several times through their entire rotational range. The switch contact wipers will usually clean themselves with this simple procedure. They're normally plated with silver, and even though the silver appears black because of tarnish, silver oxide is nearly as good of a conductor as shiny silver, so don't be fooled into thinking that a "really good" cleaning is needed. Looks can sometimes be deceiving.

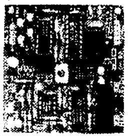
I'll return with more Ham To Ham tips, suggestions and techniques next month, but in the meantime, jot down some of your ham-related favorites and send them to me at the address shown near the beginning. I'm not able to return all submissions, however, so please make sure that you send non-essential copies, or include a self-addressed and stamped envelope for any material that you must have returned to you and I'll do my best to get it back—no guarantees though. But here's the best part, Uncle Wayne Green will send you ten dollars for every tip that we use in this column, plus make you a hero with all of your fellow hams! What an incredible deal!

73, DE Dave, NZ9E

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73 Magazine*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73 Magazine* for any equipment damage or malfunction resulting from information supplied in this column. Please send all correspondence relating to this column to *73 Magazine's* Ham To Ham column, c/o Dave Miller, NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributor's ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73 Magazine*.

Unique Ham Devices

CK-53 CW Keyer / Monitor



The CK-53 provides monitoring and display of Morse code transmissions using your personal computer. The CK-53 is also a keyer translating your keyboard entries into perfect code. Included PC software provides monitoring, control, and logging of QSOs. Features code speed 5 to 35 WPM with auto speed tracking. Complete with 2.5" by 3" assembled/tested PCB, software (3.5" or 5.25" disk), and detailed users manual.

Perfect for learning or building code speed!

CK-53 $79.95 + S&H

LTZ-01 Long Tone Decoder

The LTZ-01 is a remote control / alert module. Two relays are completely controllable via DTMF tones received from your radio or scanner. With a few $ of parts (or the CKLZ-1) can be used to monitor DTMF activity. Complete with 2" by 3" assembled and tested PCB, Software (3.5" or 5.25"), installation parts, and detailed users manual.

LTZ-01 $89.95 + S&H

CKLZ-1 Display Module

Two line by 16 character LCD display module works directly with either of the above products. Includes assembled/tested, 2.25" by 3.3" module, and manual. Twenty percent discount with purchase of one of above.

CKLZ-1 $59.95 + S&H

Additional discounts available. Call for information.

Advance Design Labs, Inc. (800) 701-8873
3245 N. Courtenay Pkwy (407) 636-8096
Suite 69 FL. add 6%
Merritt Island, FL. 32953 VISA\MC\COD

CIRCLE 161 ON READER SERVICE CARD

C.P.I.

Dealers for Kenwood, Yaesu, Icom, Cushcraft, AEA, Kantronics, Bencher, Diamond, Astron, MFJ, Hustler, Ameritron, Larsen, ARRL, and more...
Service is also available.

Get your best price then call us LAST!!

(801) 567-9494 - (800) 942-8873
7946 South State Street
Midvale, UT 84047

CIRCLE 156 ON READER SERVICE CARD

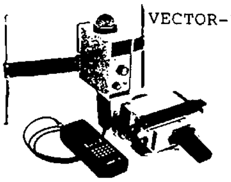
ULTIMATE MODIFICATION BIBLE VOL. IV
NEW AND MORE COMPLETE!!!

- OVER 800 MIKE WIRING CODES FOR CB AND HAM RADIOS.
- OVER 400 CB POWER/MODULATION BOOST INSTRUCTIONS.
- OVER 200 MOD. FOR CB PLL'S.
- OVER 175 MOD. FOR HAM RADIOS.
- OVER 50 COMPLETE SYNTHESIZED CRYSTAL CHARTS WITH INSTRUCTIONS.
- OVER 25 SCANNER MOD. AND TEN METER RADIO MOD.
- OVER 20 PRECALCULATED MOD. CRYSTAL CHARTS.
- LINER SCHEMATICS AND ANT/COAX db GAIN/LOSS CHARTS.

KDC SOUND $29.95
17294 FM 3083 Orders Only: 1-800-256-9895 MONEY ORDER, COD
Conroe, TX 77302 All Other Calls: 409-231-3753 MC/DISC./VISA OR CK

CIRCLE 151 ON READER SERVICE CARD

DIRECTION FINDERS



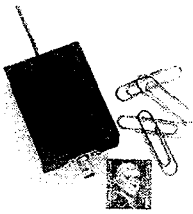
VECTOR-FINDER
HAND-HELD PHASE SENSE ANTENNAS FOR VHF DIRECTION FINDING. USES ANY FM RCVR. ARMS FOLD FOR STORAGE.

TYPE VF-142 144-220 MHZ $139.95
TYPE VF-142Q LEFT-RIGHT LEDS & AUDIO, 144-220 MHZ $239.95
TYPE VF-142QM SAME AS Q MODEL EXCEPT FREQ.144-500 MHZ $289.95
TYPE VF-121Q SAME AS VF-142Q PLUS 121.5 MHZ ELT FREQ $379.95
CALL ABOUT HF DF, ATTENUATORS
ADD $4.50 S/H CA ADD TAX

RADIO ENGINEERS
7969 ENGINEER RD, #102
SAN DIEGO, CA 92111
619-565-1319 FAX 619-571-5909

CIRCLE 58 ON READER SERVICE CARD

UHF VIDEO TRANSMITTER



Miniature 200 Mw p.e.p. Video Transmitter
Built tough. Housed in a black anodized milled aluminum case with stainless steel SMA antenna connectors & screws.
Available either at 434 mhz or 423.25 mhz
Using SAW Resonator technology

$279 plus s/h $5
Check, Money Order, Visa or Mastercard
CA Res. add 8.25% tax

TECHNICAL

Modulation Type:	AM
Voltage:	12 vdc - 100 ma
R.F. Output:	200 mw PEP
Frequencies:	434 Mhz, 423.25 Mhz Specify when ordering
Dimensions:	17/8"L x 1-3/8" W x 5/8" H 47mm L x 34.5 mm W x 15mm H

A.I.G., INC.
P.O. Box 642057
Los Angeles, CA
90064-2057
TEL: 310 821-6770
FAX: 310 821-6690

SAM Amateur Radio Callsign Database

Find Hams quickly and easily by Callsign or by Name. Search for a specified City, State, or Zip Code. Print with standard or customized output. Ideal for mailing lists, QSLs, etc. Search filters allow you to specify FIRST NAME, LICENSE CLASS, AGE, ADDRESS, or CALL SUFFIX, AREA, OR PREFIX.

New For '96

Each U.S. entry includes callsign, name and address, county, license class, date of birth, license expiration date, previous call and date first licensed.

Available on 3.5" or 5.25" HD floppies $49.95, s/h $5 (available January '96) or CD-ROM $39.95, s/h $5 (available October, January, April, or July).

Yearly update subscriptions available on all medias.

RT SYSTEMS, INC.
8207 STEPHANIE DRIVE, HUNTSVILLE, AL 35802
1-800-723-6922 or 1-205-882-9292
Visa, MasterCard, AMEX, or Discover

CONNECTORS - MADE IN USA

PL-259ST	Silver Teflon	$1.00 ea.
PL-259 STG	Silver Teflon Gold Pin	$1.19ea.
PL-259GT	Gold Teflon	$1.29ea.
9913 2 Pc. N Connector With Silver Teflon and Gold Pin	(Install like PL-259)	$3.00ea.

COAX CABLE

RG-213/U	Type IIA, 95% Braid	.33/ft.
RG-8X	Type IIA, 95% Braid	.14/ft.

450 OHM LADDER-LINE

16 Gauge	Stranded Cu-clad	.15/ft.
18 Gauge	Solid Cu-clad	.12/ft.
300 Ohm	KW Twinlead	.12/ft.
72 Ohm	13 Gauge Twinlead	.20/ft.

ANTENNA WIRE

#14 7/22	Hard Drawn Copper	.08/ft.

INSULATORS

Dog Bone Type Antenna insulators	.50/ea.
HI-Q Antenna Ins. 6 3/8" Long	$3.95/Pr.
450 Ohm Ladder-line Insulators	.49/ea.
Ladder-line Coax Cable Adaptor	$5.95/ea.

ALL BAND DOUBLETS

With 100 feet of 450 Ohm ladder-line

All-Bander	135 Feet Long	$29.95PPD
Shorty All-Bander	70 Ft. Long	$44.95PPD

G5RV ANTENNAS

G5RV-MB 80-10 Meters, 102' Long
With Xfmr & 70' RG-8X $49.95PPD
G5RV-E 80-10 Meters, 102' Long
No Xfmr or Cable Only $28.95PPD
G5RV-JR 40-10 Meters, 52' Long
No Xfmr or Cable Only $24.95PPD

SLOPER ANTENNA

Complete Kit With Instructions

SLA-I 160,80 &40 Meters, 60' $49.95PPD
SLA-IC Coils Only For SLA-I $24.95PPD

HALF-SIZE DIPOLES

Complete Kit With Instructions

HSD-160	160 Meters	135' Long	$49.95PPD
HSD-80	80 Meters	70' Long	$47.95PPD
HSD-40	40 Meters	35' Long	$44.95PPD

Add Shipping To All Non-postpaid Items
Add 10% Or $4.00 Minimum To Order
Ohio Residents Add 7% Ohio Sales Tax

VGE / VAN GORDEN ENGINEERING
Box 21306, S. Euclid, OH 44121
Phone 216/481-6590 - Fax 216/481-8329

CIRCLE 97 ON READER SERVICE CARD

C. W. WOLFE COMMUNICATIONS

BUY · SELL · TRADE
All Brands of 2 Way Radios and Equipment

1113 Central, Billings, MT 59102
406-252-9220 Fax: 406-252-9617
Call or write for current flyer

Number 68 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D. WA3AJR
6 Jenny Lane
Baltimore, Maryland 21208

I don't know about you, but I feel especially warm and fuzzy this year. They say that "into each life some rain must fall," and, without going into details, my family has been inundated in a monsoon this past year. Therefore, in honor of the winter holidays and their traditions, let me make some suggestions for gifts to make the digital amateur happy.

Kantronics offers their KAM Plus, a packet controller that operates any of the popular HF digital modes and VHF packet, simultaneously. In one small package, they pack enough features to make just about anyone on packet, RTTY, or AMTOR happy.

This is the "Home-brew" issue, and if you are interested in putting together your own station, from the board level up, you might do well to look at Hamtronics. They have transmitter and receiver boards for VHF and UHF, most under $200 each. How about a 1200-baud modem kit for fifty bucks? This is only a sample of what Hamtronics has for the RTTYer. A catalog and gift certificate may be just what the doctor ordered.

Speaking of home-brew, TEC-200 film is an interesting product. If you have a ham interested in construction, and are looking for an inexpensive gift, you could do a lot worse than five bucks for this stuff. Copy the circuit onto the film using a plain paper copier, iron it onto the circuit board, peel and etch. Sounds neat, and worth looking into. The Meadowlake Corporation makes the stuff available. Let me know what you think.

I mentioned Buckmaster a while back, and they have some nifty items for the ham on the list. CD-ROMs with international call sign databases for fifty bucks, or with a collection of shareware programs and data files for half that price are just two of the items available. Check with them to see the latest material available on this exciting new medium. Then again, if you are flush with funds, check out the complete collection of 73 Magazine on microfiche for $285. Oh, well, if only they offered this on CD-ROM! (Hint . . . hint!)

Another call sign database is the SAM database, available on either floppy disk or CD-ROM for forty dollars. Several options are available, to allow county reference, license expiration, birth date, or others. Check this one out through RT Systems, Inc.

Ramsey Electronics has been a perennial favorite for little kits and things. Between transmitters and receivers and DTMF boards, this is another potential catalog and gift certificate item. Check it out and see if you don't agree.

With the number of questions I get every month about Baycom, let's not forget Tigertronics and their BayPac modem. This little modem, designed for Baycom, costs about fifty dollars, and is just a tad larger than a DB-25 plug. This may be just the ticket for turning that laptop and hand held into a packet station.

Now, for those of you who still use mechanical teleprinters, a few little sources and tips. Ribbons labeled for Model 15s may not grace the shelves in your local office supply store, but Underwood typewriter ribbons are usually at the top of the list. They will work just fine. Get the heavier type, for longer life. Lithium grease, perfect for lubricating the vanes and levers, may be found at the automotive counter in little tubes, perfect for the tool box. Restore the black crinkle finish of your machine's cabinet with liquid black shoe polish, if it is just a tad dirty. If the paint is badly messed up, there are spray crinkle finishes in the hardware or paint store, although they take a bit of practice to use right. While you're in the stationery store, pick up some type cleaner for those Model 15s and Model 28s. They have putty types, typing sheet types, and liquids with brushes, messy as that sounds. Look around, I'm sure there will be something of interest.

Now, the computer-type digital hams have a veritable plethora (there I go again) of goodies to choose from these days. From inexpensive floppy disks, disk holders, copy stands, screen cleaners, mouse pads, and who knows how many other ten-dollar and under items, the sky is the limit if you care to spend some real money. Anyway, if you are shopping for the computing ham, your best bet may be a gift certificate from the local computer superstore.

In keeping with this month's theme of gift giving and neat products, this month's world wide web site is a potential source for many a gift. The Raymond Sarrio Company has listed an amateur radio discount catalog on the web, which promises prices below retail. Take a look for yourself at:

http://www.csz.com/sarrio.html

and let me know what you think.

Incidentally, all listings for items or sources in this month's column have come through my perusal of ads, literature, or other such material. No manufacturer has solicited space in this column, nor are many even aware of this column's existence, for that matter. Therefore, if you contact any of these folks, be sure to tell them that you read about their fine wares in *73* magazine's RTTY Loop column, okay? I mean, might as well boost the column and the magazine when you can.

Can I put in a specific plug for the column here? Okay, regular readers of RTTY Loop are quite aware of the RTTY Loop Software Collection, a compendium of software, primarily for the PC-compatible crowd, that caters to the widest variety of digital amateurs. Now up to a dozen disks, each one may be yours by sending me a blank 3.5-inch high-density disk, a stamped self-addressed disk mailer for return to you, and $2.00 in US funds per disk, to the address at the top of the column. Now, I would not expect you to just order the disks blindly, and we have covered the contents of some of these disks before. A full listing is available by snailmail, by sending me a self-addressed, stamped envelope for return of the printed listing, or via E-mail, to any of my electronic mailboxes:

CompuServe—75036,2501
Delphi—MarcWA3AJR;
America Online
MarcWA3AJR;
Internet—
MarcWA3AJR@aol.com

Even if you don't want to ask about the disks, I look forward to your comments, questions, and suggestions. Talk about gifts, your input is just what I desire! My very best wishes to each and every one of you for a Happy Chanukah, Merry Christmas, Joyous Kwaanza, and a Healthy and Successful New Year. 73

Sources for items mentioned in this month's column:

Kantronics,
1202 E. 23rd Street,
Lawrence, KS 66046-5006;
(913) 842-7745.

Hamtronics, Inc.,
65-D Moul Road,
Hilton, NY 14468-9535;
(716) 392-9430.

The Meadowlake Corporation,
Department J,
P.O. Box 1555,
Oneco, FL 34264.

Buckmaster,
Route 4, Box 1630,
Mineral, VA 23117;
(540) 894-5777;
http://www.buck.com.

RT Systems, Inc.,
8207 Stephane Drive,
Huntsville, AL 35802.
(205) 882-9292.

Ramsey Electronics, Inc.,
793 Canning Parkway,
Victor, NY 14564;
(716) 924-4560

Tigertonics, Inc.,
400 Daily Lane,
P.O. Box 5210,
Grants Pass, OR 97527;
(503) 474-6700

Number 70 on your Feedback card

HOMING IN

Homing In Radio Direction Finding

Joe Moell P.E. KOOV
PO Box 2508
Fullerton, CA 92633

Foxhunting's Wide World

For many years, weekend television featured a sports program that celebrated the thrill of victory and the agony of defeat. It covered prominent and obscure sports of every kind, from arm-wrestling to Zamboni-racing. But there is one sport I never saw on this or any other show, despite the fact that thousands engage in it every year in dozens of countries around the world. Most of those who do it are hams, but a ham license is not required in order to compete.

The sport I'm referring to has a number of names including foxhunting, foxteering, and foxtailing. The "foxes" being hunted aren't animals, they are low-powered radio transmitters. The competitor who uses his or her personal radio direction finding (RDF) equipment to locate the most foxes in the shortest time wins. Foxhunting contests are held all over the world, sanctioned by the International Amateur Radio Union (IARU). Local, regional, national, and international champions are chosen in separate rounds on 80 meters and two meters. Hunters are scored individually and as national teams.

Unfortunately, North Americans have never won an IARU-sanctioned international foxhunt. In fact, only a few from this continent have ever participated in this kind of radio sport. Why? Because hams here have a different view of how to play hide-and-seek with radios. We usually call it T-hunting or bunny-hunting. Instead of running through the woods, we drive for a while (sometimes a long while), then go on a short on-foot "sniff" at the end of the hunt.

Many hams tell me that the "sniff" is their favorite part of T-hunting. If you feel that way, you'll love international-style foxhunting. Maybe you have what it takes to become a world champion!

Photo A. IARU rules call for hunters to start through a 50-meter corridor, turning on their gear when they reach the end. The space between two areas of the Marine Mammal Care Center made an excellent corridor for Hamcon/Foxhunt-95, because waiting contestants could not easily see in which direction earlier starters went. Kevin Kelly N6QAB is off and running, followed by Ken Mirabella KM6YH

Hamming Your Way to Fitness

Unlike American-style mobile T-hunts, an international-rules foxhunt is a formal event. It takes lots of preparation and on-site staffing to put one on. Sanctioned hunts must follow the 12-page IARU document, "Rules for Championships in Amateur Radio Direction Finding."

An IARU-rules foxhunt course comprises five low-power (0.25 to 1.5 watt) fox transmitters in a hilly wooded area of about six square kilometers. The foxes are spaced such that the shortest distance from the starting point to each one and then to the finish line is 5 to 12 kilometers. Foxes must be at least 400 meters apart. The first must be at least 750 meters from the start.

Each fox transmits for 60 seconds, one after another in numbered sequence, all on the same frequency. A continuous transmitter on a different frequency at the finish line helps hunters find their way home to the finish line oonce they have found all five foxes and marked their scoring cards with the unique punches attached to each fox. Scores are determined primarily by the number of transmitters found, and secondarily by elapsed time. Contestants are individually timed. They start at five-minute intervals, coinciding with the start of fox #1 transmissions. This scatters the contestants on the course to minimize "follow the leader" problems.

Foxhunting is a map-and-compass exercise as well as an RDF test. Successful hunters pay careful attention to their exact location and the bearings to all foxes at all times, plotting them on detailed topographical maps provided by the organizers. They know that if they miss a fox bearing, they must wait four minutes to hear that fox again. They also eye their watches, since exceeding the time limit (100 to 140 minutes) means disqualification. In other words, it is better to return under the time limit with only one fox found than to find all five but take one minute over the limit.

Each target transmitter has distinctive identification, sent continuously in CW or MCW. Fox #1 sends "MOE" continuously, plus callsign. Fox #2 sends "MOI," fox #3 sends "MOS" and so forth. Even without knowing Morse Code, contestants can identify the individual foxes by counting dits.

To aid competitors who get lost, a homing fox at the finish line transmits "MO" continuously on a separate frequency. Two meter foxes in IARU championships transmit AM with tone modulation. Eighty-meter foxes send keyed CW. The 80 meter and 2 meter events are on separate days so each entrant can compete on both bands.

Under IARU rules, all competitors use the same venue and the same foxes, but they are divided into four separate divisions: Seniors (males 18 to 40 years), Juniors (boys under 18), Women (any age—nobody asks!), and "Old Timers." Only Seniors are required to find all five foxes, in any order. Others need find only four foxes; the designated four are different for each division.

Each country entering a championship match may field one or more teams of three to five contestants each. Team score is a function of the best three individual scores. Team members are not allowed to help one another; Course Marshals are alert for violations. Medals are awarded to top team and individual entrants. This makes for a total of eight individual and eight team medal sets awarded in gold, silver, and bronze at a championship meet. There are no cash or merchandise awards.

Foxhunting World Championships take place every three years. The seventh was in September 1994 at Sodertelje, Sweden, about 25 miles southwest of Stockholm. In the years between, regional meets are scheduled. IARU Region 1 (Europe and Africa) held its championships in September of this year in Chtelnica, Slovakia, with twenty countries represented.

In IARU Region 3, China and Japan are the countries with greatest foxhunting activity.

Others, such as Australia, are becoming more and more involved in the sport. National ham societies such as Japan Amateur Radio League sponsor foxhunting as a means of recruiting newcomers to the hobby. Australia will host the next IARU Region 3 Championships at Townsville, Queensland, in July 1996.

What about IARU Region 2, which encompasses North and South America? Sad to say, there

Photo B. With four age divisions and five cash prizes in each, many Hamcon foxhunters finished "in the money." Happiest of all was Scot Barth KA6UDZ (kneeling), who received the mounted-compass Sweepstakes Award for fastest overall time (1:06:21) to find all foxes

are no IARU-sanctioned foxhunts here, despite the fact that ARRL Headquarters in Newington is the International Secretariat for IARU. Presently, hams from Region 2 who want to compete in IARU championships must travel overseas and enter unofficially. IARU events have a "friendship" category for participants who are out of their region or are not national champions. There is also a "promoters" section for newcomers wishing to run the course without being part of the actual competition.

Before we can convince ARRL and IARU to hold championships in Region 2, many more T-hunters (and some League officials) must learn about the fun of international-rules foxhunting and practice it to gain proficiency. Several individuals and groups in the USA and Canada are promoting this radiosport, as you will see in upcoming "Homing In" columns. This month, I'll tell about what's happening in southern California.

Hamcon-95

It all started when the Southern California Six Meter Club (SC6MC) volunteered to put on a transmitter hunt for Hamcon-95, the ARRL Southwestern Division Convention on the Queen Mary during Labor Day weekend. Sunday afternoon Southwestern Division convention T-hunts are a tradition that goes back over 15 years. Up until this year they have always included long-distance drives. Many have had multiple transmitters. The lure of hefty cash prizes brings out up to twenty mobile teams to Hamcon hunts. SC6MC T-hunt chairman Bob Hastings K6PHE and wife Gracie KK6CG have enjoyed small-scale on-foot foxhunts put on by the United Radio Amateur Club of Los Angeles, so, when someone suggested an all-on-foot foxhunt for Hamcon-95, they agreed immediately. As an incentive for a good turnout, Hamcon organizers approved $500 in cash prize money and the SC6MC board agreed to spend $200 on trophies, certificates, and refreshments.

Here was a chance to introduce the T-hunters of southern California and Arizona to international-style foxhunting. To do that and to convince the convention organizers that their money was well spent, a good turnout was important. Convention-goers had to be told in advance to plan on staying in the Long Beach area through Sunday and to bring on-foot "sniffing" gear.

Beginning in early August, the word went out by repeater bulletins, packet, Internet, and on-line services that a new and exciting kind of transmitter hunt was on the agenda for Hamcon-95. The announcements included a summary of international-style foxhunt rules and suggestions for simple foxhunting equipment. Convention-goers were invited to sign up for the hunt and also to attend a two-hour Foxhunt Forum at the convention center Saturday morning. At the forum, a room full of neophyte and old-time RDFers heard all about international hunts from your columnist and two other hams who have experienced them, J. Scott Bovitz N6MI and Kevin Kelly N6QAB.

Three weeks before the convention, it was my duty to be hider for the Los Angeles area "Pathfinder" Saturday evening mobile T-hunt. It turned out to be an opportunity for hunters to practice for Hamcon/Foxhunt-95. It was also a chance for me to try in-the-park hiding and get a better idea of what makes a fox location easy or hard. WA6OPS and I put the mobile hunt T in a ravine in Rancho Cucamonga, 18 miles from the starting point. Its beam was pointed so as to create signal reflections from the nearby San Gabriel mountains, just so it wouldn't be too easy.

The ravine was just east of a beautiful 40-acre park, where we concealed six miniature foxes. When hunters found the ravine transmitter, a note instructed them to come to the park, where we gave them competitor cards and told them to hunt down transmitters #2 through #7. We timed each person start-to-finish, just as in an international-rules hunt. A dozen hams tried the park course. All had fun, and many decided then and there to try hunting for dollars at the convention.

No Forests Here

The biggest problem in putting on Hamcon/Foxhunt-95 was locating a suitable site. A dense forest is best because navigation is more of challenge and hunters can't observe one another unless they are very close. Unfortunately, the closest forests to Long Beach are dozens of miles away and they aren't very dense anyway. K6PHE and KK6CG suggested Angel's Gate Park, which turned out to be an excellent choice.

This 130-acre complex is only a ten-minute drive from the convention center. Only a small part is wooded, but the rest has an abundance of interesting features to make up for that. Fort MacArthur Military Museum is there, with dozens of old buildings, bunkers, and fortifications, perfect forconcealing radio foxes. This park overlooks the Pacific Ocean, so moderate temperatures prevail during the day. This is important, because afternoon highs often exceed 100 degrees around Labor Day just a few miles further inland.

Our goal was for Hamcon/Foxhunt-95 to be as close to an IARU-rules hunt as practical, but we made a few changes to

Continued on page 78

BARTER 'N' BUY

Number 72 on your Feedback card

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

The deadline for the February 1996 classified ad section is December 12, 1995.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALL ABOUT BOOKS,** Dept. S, P.O. Box 22366, San Diego CA 92192.
BNB200

KENWOOD AUTHORIZED REPAIR. Also ICOM, Yaesu. **GROTON ELECTRONICS,** Box 379, Groton MA 01450. (508)448-3322.
BNB310

NOW ON 40 METERS! NEW, KNOB-TUNED w/DIGITAL DISPLAY, SYNTHESIZED qrp transceiver. Complete kit only $199.95. S&H $7.50 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661.
BNB334

RCI-2950/2970: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd in U.S. (Missouri residents add $1.15 tax). **SCOTT**, P.O. Box 510408, St. Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D.
BNB340

NI-CO BATTERY analyzer cycler. PC controlled. DOS software, $289. PO Box 672, London, Ontario Canada N6A 4Y4 **Lamantia Products** 519-472-5566 Fax 519-472-1702
BNB385

CODE 5 News and Petition information. SASE to **KB7PNO**, 503 Dubois Street, Cheney WA 99004.
BNB1012

IT'S BACK! The return of the HW-8 Handbook! Second printing. Modifications for the Heath **QRP** rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce, WB8VGE,** 2225 Mayflower NW, Massillon OH 44647.
BNB404

ASTRON power supply, brand-new w/warranty, **RS20M** $95, **RS35M** $139, **RS50M** $199. Call for other models. **818-286-0118.**
BNB411

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby, (Copyright 1967). Second printing available from JOHAN K.V. SVANHOLM, N3RF, **SVANHOLM RESEARCH LABORATORIES,** P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H
BNB420

QRZ! CALLSIGN DATABASE ON CD-ROM $16.95!!! Over 935,000 callsigns, thousands of ham programs, mods, etc. Runs on OS/2, **WINDOWS, DOS,** and **UNIX. To order call** 1-800-260-8860, 1-909-517-1100, or fax (24 hrs) 1-909-517-1105. **Rom-Dezvous Multimedia,** 3811 Schaefer Ave. Suite 1, Chino CA. 91710. S&H $5.95. Visa, MC, Disc, Amex, personal checks.
BNB440

HAMS—NEED COMPUTER RIBBONS? Lowest prices. Color or black. State your needs. Free info. **HARCLY(I),** P.O.Box 830A, Coquille OR 97423.
BNB457

HEATHKIT WANTED! S.B. Series **'Green Front'** for parts. **Robert Schlegel,** 2302 286th St. East, Roy WA 98580
BNB910

ELECTRON TUBES: All types and sizes. Transmitting, receiving, microwave . . . Large inventory = same day shipping. **DAILY ELECTRONICS,** 10914 NE 39th ST. Suite B-6, Vancouver WA 98682. (800)346-6667 or (360)896-8856.
BNB719

WANTED: HAM EQUIPMENT AND RELATED ITEMS. Donate your excess gear, new, old, in-any-condition, to the **Radio Club of Junior High School 22,** the Nation's only full-time, nonprofit organization working to get Ham Radio into schools around the country, as a teaching tool, using our **EDUCOM—**Education Thru Communication—program. Send your radio to school. Your donated material will be picked up **ANYWHERE** or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 15th year of service. It is always easier to donate and usually more financially rewarding, **BUT MOST IMPORTANT** your gift will mean a whole new world of educational opportunity for children nationwide. Radios you can write off, kids you can't. Make 1995 the year to help a child and yourself. Don't delay-**contact us today-95 will be over soon.** Write, phone or Fax the WB2JKJ "22 Crew" today: The RC of JHS 22, POB 1052, New York NY 10002. 24 hours call 516-674-4072 or Fax 516-674-9600. Join us on the WB2JKJ CLASSROOM NET, 7.238 MHz 1200-1330 **UTC** daily, and 21.395 MHz from 1400 to 2000 **UTC.**
BNB762

Amateur Radio T-Shirts & Sweat Shirts. Electonics Books. Send for **catolog.** Paul Washa, 4916 Three Points Blvd., Mound MN. 55364-1245
BNB805

R-390A SALES & SERVICE. INFO SASE MILTRONIX POB 80041 TOLEDO OHIO 43608. R-390 POWER INPUT CABLES $25.00, ANTENNA CONNECTORS $12.50, EXTERNAL AGC MOD $20.00 PPD. **MON-FRI** 9AM-6PM E.S.T. (419) 255-6220.
BNB813A

ELECTRONICS GRAB BAG! 500 pieces of new components: inductors, capacitors, diodes, resistors. $5.00 postpaid. **ALLTRONICS,** 2300 Zanker Rd., San Jose CA 95131.
BNB855

Test Equipment: Ballantine 320 RMS Voltmeter $60; Ballantine 323-07 RMS Voltmeter $150; Fluke 1120A **IEEE**-488 Translator $100; Fluke 2020A Printer $75; **GR** 1390-B Noise Generator $60; HP 403B AC Voltmeter $70; HP 431C/478A Power Meter $250; HP 461A Amplifier $100; List available. Phone: (908)722-6157. Fax: (908)722-6391.
BNB1037

RF TRANSISTORS, Japanese transistors and tubes need dealers, repair shops, kit makers, etc. for 2SC1969, 2SC2312, MB8719, MRF455, MRF454, 2SC2879 and more. **WESTGATE** (800)213-4563.
BNB950

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone** (616)925-5899, 8-4 **ET.**
BNB964

PRINTED CIRCUIT BOARDS for projects in *73*, *Ham Radio*, *QST*, **ARRL** Handbook. List SASE. **FAR CIRCUITS,** 18N640 Field Ct., Dundee IL 60118.
BNB966

AZDEN SERVICE by former factory technician. **SOUTHERN TECHNOLOGIES AMATEUR RADIO INC.,** 10715 SW 190 St. #9, Miami FL 33157. (305)238-3327.
BNB979

ROTOR PARTS ROTOR SERVICE, ROTOR accessories: Brak-D-Lays, Quik-Connects, Pre-Set mods. NEW models for sale. Free catalog. **C.A.T.S.,** 7368 State Road 105, Pemberville OH 43450.
BNB996

Wanted for Museum: Apple-1 and other pre-1980 microcomputers. Also early microcomputer journals, newsletters and advertising literature. **KK4WW,** 703-231-6478/763-2321.
BNB1001

STOCKING STUFFER! Give the gift of music this holiday season to your favorite Ham. Order **THE RHYTHM OF THE CODE** Morse code music cassette tape. Send only $9.95 add $2.00 S&H to **KAWA Records, P.O.** Box 319, Weymouth MA 02188; or Visa-MC call 617-331-1826 after 4PM EDT weekdays.
BNB1020

QSL CARDS Many styles. Top quality. Order Risk Free. Plastic cardholders, T-Shirts, Personalized caps, mugs, shirts. Other ham shack extras. Information and samples. **Rusprint.**1-800-962-5783.
BNB1021

TIRED OF IRONING? Single/small quantity ss PCB service. Most boards $25. We scan magazine artwork free. Get out those back issues! **FIRST PROTO.** (919)403-8243.
BNB1022

WANTED: BUY AND SELL All types of Electron Tubes. Call (612)429-9397, Fax (612)429-0292. **C & N ELECTRONICS,** Harold Bramstedt, 6104 Egg Lake Road, Hugo **MN** 55038.
BNB915

Continued on page 88

NEVER SAY DIE

Continued from page 4

industry has bought and paid for a few senators, it isn't.

Well, the congressional brakes have been on when it comes to EMFs also, with the power companies facing hundreds of billions of dollars in expense in meeting any reasonable magnetic field limitations.

Thus I was surprised and delighted to read a report from the National Council on Radiation Protection and Measurements (NCRP) committee which calls for strong action to stop the exposure of the US population. It endorses a 2 mG exposure limit, to take effect immediately for new day care centers, schools, playgrounds, and new transmission lines near existing housing. And it would be phased in more slowly for existing schools, housing, and businesses.

The report was funded by the EPA and has been called by them to be "the first comprehensive review of the world's literature on EMF health effects."

The government's past field strength guidelines have been set at 10,000 mG for a few hours a day for the public and 5,000 mG for the constant exposure by workers, so the new guidelines lower them by over a thousand times! Are you still using that electric blanket?

It's an 800-page report, so I won't cover it all. But, in essence, what I've been saying about the exposure to magnetic fields has been right on the money, with no exaggeration. The report shows that there is "a positive association between childhood cancers and exposure to EMFs generated by electric power transmission and distribution systems."

The action of these fields on the faster-growing cells of children and unborn babies is more evident, but there is plenty of evidence that the slower-growing cells of adults are also affected, and the effects are not in any way beneficial. Another case of slow poison for you.

So, compare this report with the recent rash media baloney saying that EMFs have not been proven to be dangerous. Don't the power companies wish! But the power companies advertise in our newspapers, on the radio and TV, and have been bribing the heck out of our congress, so they tend to control the media and the government. If they would spend a little of the money we're paying them for power to help develop cold fusion power generators instead of PR aimed at staving off the inevitable, we'd have much cleaner air and cheaper electricity.

We're seeing a replay of the cigarette and asbestos episodes in our history. Well, if congress can't get itself to be honest with cigarettes, maybe the FDA will get into the act.

And I'm no fan of the FDA. With 95% of our FDA approved drugs never proven to be effective (bet you didn't know that!), and no efforts at all to check any alternatives not coming from the pharmaceutical industry, the FDA is a tyrant which seems to be hurting us far more than helping. It seems to be a tool of the pharmaceutical and health insurance industries, and in bed with the AMA, which is not famous for its ethics.

Hmm, I can see the headlines now, "Wayne Green shot by unknown assailant."

Now, if you still disagree with me about EMFs, and you're not doing it out of ignorance, then let me see your data. I've been doing my homework on this for several years and the NCRP chairman is a good friend of mine.

Well, it's good to see that the government may finally be lumbering into action on EMFs.

Repeater Groups, Please Advise

With the FCC getting fed up to here with complaints about repeaters, and with no help seemingly available from the ARRL and their Repeater Advisory Committee, things have taken the course you might expect when there are few guidelines and ample room is left for the expansion of egos.

Starting from the top, one of the last things in the whole world amateur radio needs is to ignore any situation that is causing the

FCC agitation. We're on very thin ice as it is, so we really don't need to poke the lion with a sharp stick. Remember, we're dealing with political appointees and bureaucrats. The appointees (Commissioners) have more politically important things to worry about than amateur radio, what with the incredible growth of communications technology, so we don't want to be in the position of a bothersome fly that is causing aggravation and is more likely to get swatted than cared for.

Sure, within my memory amateur radio was paying it's dues by supplying trained or at least trainable technicians and operators in time of war. It was, until 30 years ago, the major supplier of high-tech career oriented youngsters. It was also the pioneering ground for new communications technologies—up until 30 years ago. It used to be a major factor in providing emergency communications, but CB, cellular telephones, and improved business and government communications systems are phasing us out in this arena.

Thus, every complaint to the FCC is like a fly buzzing around, asking to be swatted. Even more irritating and alarming to the Commission are the complaints delivered via a member of Congress to the FCC from a ham constituent.

What Are The Beefs?

State repeater coordinator groups are, by and large, doing a fine, if often thankless, job of assigning channels for their areas. But where a resource is finite, there are going to be arguments and bitching over it's use. This natural source of contention has been made worse by some coordinators taking advantage of their position of responsibility. Bribery, the patronizing of friends, and such have been causing complaints. When a new group wants to set up a repeater and is told that there are no available channels, they tend to get upset. And when they find that one individual has eight repeater channels assigned, six of which are rarely in use, this does not make for happy campers.

I get around the country quite a bit. In each city I visit, I check out the repeater channels, looking to say hello. And I listen and scan the 2m band to see how much repeater activity there really is. When I'm able to call in on a dozen repeaters, with no one answering my call on any of them, what am I to think? When I scan the band and hear maybe one repeater in action in an area where there are no more available channels, I know something's wrong. In other towns I try the listed repeaters and find that virtually all of them are guarded against me by PL access. They're private. No trespassing. Visitors keep out. Non-paying hams keep out.

So we have hams complaining to the FCC, writing their congressmen, and even suing. None of these approaches are going to do any good, and the chances are they can do a world of harm.

The FCC vs. the ARRL

When the FCC put increased pressure on the ARRL to take more responsibility in mediating repeater problems, thus taking the heat off the Commission, the League called a meeting of the coordinators. The coordinator groups were instantly suspicious of Big Brother stepping in and telling 'em what to do. Well, the FCC is pushing for one "point of contact" to deal with repeater problems, so what organization would be more logical than our only national ham organization? Alas, the ARRL's reputation for even-handedness is not shining. They have always tended more toward running amateur radio as a dictatorship than a democracy and, while League aparatchiks are comfortable being told what to do, we still have a few hams who prefer that their opinions be considered.

Through some genetic mishap, I'm one of the trouble-makers who doesn't like to be told what to do. Ask me and I'll do just about anything. Tell me, and go to hell. Thus I've been an enemy of dictatorships, communism, and socialism, much preferring democracy. Yes, it's been a losing battle in America, with socialist programs smothering our school system, health care, welfare, and so on, through a dozen generous government bureaus.

In the ham field, I agree we need a national organization, but I think it should be structured opposite from what it is. I believe that QST should be a communications medium for the discussion of proposals for rule changes, and that the directors should poll ham

Continued on page 76

NEVER SAY DIE

Continued from page 75

present these at director's meetings, just as our congressmen are supposed to do. And probably would do if we would stop lobbyists from buying their influence. So, instead, we have the ARRL board making the decisions and the directors then telling the unwashed what they are. The word goes down from on high, not up from the members.

This is not the system that I would want making decisions on repeater matters, so I can understand why many coordinator groups are alarmed at the prospect of the League being set up as the single point of contact with the FCC.

I suspect that the League isn't at all anxious to have this nasty monkey on their back. It's a thankless job, complete with the potential for fighting bitter law suits. And there is no upside. It won't increase revenues. It isn't going to increase their languishing membership. And it'll obviously cost money to handle.

My recommendation was for the state and area coordinator groups to pass the hat to fund a National Coordinator Committee and hire a General Secretary — preferably a retired ham, and Lord knows we have more than enough of them. The NCC would be incorporated to limit liability and would be the point of contact for the FCC. It, in turn, would contact a coordinator when a problem arose. This approach would get the whole thing out of the political arena.

Since coordinators have a lot more to do than repeater coordination, the NCC should have a newsletter to provide communications. Coordinators have to take into consideration all VHF/UHF ham band users, not just the repeater groups. Repeaters have to live with SSB, ATV, satellites, weak signal, moonbounce, packet, and so on. So the coordinators have to agree on band plans for these bands.

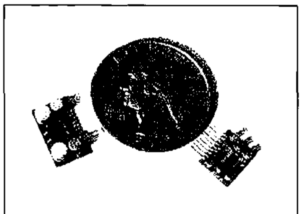
My suggestion as a way to deal with this isn't new. I propose that the NCC hold a biennual (every other year) national conference where all proposals for FCC rule or band plan changes would be discussed and voted on by delegates from interested clubs and coordinator groups. I talked this over with the FCC Commissioners a few years ago and they thought this was a great solution to the aggravation and cost of their dealing with amateur radio rule changes. They agreed that the Commission would supply legal help for any such conference to help expedite new rules being enacted. This would make it so our amateur radio rules could be more in step with technology and the current needs of the hobby.

Will Democracy Work?

Perhaps, as the Yugoslavs and more and more little wars around the world between ethnic groups are proving, mankind is not yet able to peacefully resolve differences. So perhaps my idealistic dream of a self-regulating amateur radio service is unattainable.

But we've come a long way during the almost 60 years I've been involved in the hobby. I got snickers and ridicule when I first proposed that we do our own license testing. We've gotten rid of many restrictions that hobbled us in the past. But as long as emotions rule minds, we're going to have problems.

Should we continue to encourage the use of 450 MHz for repeater linking, or should we move it on up to higher and less used bands? Without linking, what would 450 occupancy look like? Is there a need for more channels, and thus pressure to encourage the ATVers to move higher? For that matter, how many ATVers are there on 420? We need more data. And then we need the probably unattainable: cooler heads.



Are circuits getting smaller? Or is this a pre-inflation quarter?

If we can organize an NCC, I'd like to see a yearly audit of band occupancy in each area. With computer-controlled scanners it's fairly easy to run such an audit. But then we'd also want to check for legitimate usage. I still remember how the US military occupied allocated short wave frequencies by transmitting so many hours a day, whether they had any traffic or not. The use showed up on the ITU reports, showing activity, and thus preserving the frequencies. I remember visiting one of the Army stations in Heidelberg and seeing their transmitters holding down a whole list of frequencies with test transmissions.

So let's let the Tutsis and the Hutus kill each other and see if we can learn to give and take to accommodate the 73 different hobbies we're enjoying and call ham radio.

Good News For Entrepreneurs!

The socialists in congress are pushing to raise the minimum wage. This is indeed good news for entrepreneurs. Frankly, I hope they raise the minimum wage to at least $7.50 per hour, which is around $15,000 a year. How can a family live for much less than that these days, right?

Of course this will increase the costs for manufacturers to make products, forcing them to either increase their prices or get rid of workers by replacing them with automation and computers. And this is where you come in.

A good rule of thumb is to multiply the cost of manufacturing a product by about six to cover the costs of distribution and marketing. Thus any increase in worker's pay will be multiplied by six when it reaches the sales price for the product. And that will make many manufacturers no longer competitive with foreign factories, so they will either have to move their jobs to Mexico or some other lower wage country, or automate more to cut payroll.

If you spend much time on the telephone you know that more and more companies have replaced telephone operators with automated message handling systems. There are fewer and fewer jobs for low-skilled workers. And there are going to be even less.

The next time you visit a factory, take a good look at what the workers are doing. How many of them could be replaced by a computer or a computer-driven machine? Every time you can replace a worker by a machine of some kind you are going to save the company money. You'll also probably improve the quality of the product.

A worker making $15,000 a year also costs the company around $5,000 more for health care insurance, unemployment insurance, and so on. A machine doesn't come in late and leave early. It doesn't have children that get sick. It doesn't even take long weekends or have to observe holidays. No ten-minute smoking breaks every hour, either.

Companies are going to be looking for consultants who can cut their payroll, either by streamlining the work or replacing un- or semi-skilled workers with machines and computers.

This is going to come as a big surprise to the kids who are dropping out of school. McDonald's is experimenting with automated burger flippers. It won't be long before most fast food chains can be run by half as many workers or less.

For instance, suppose you could punch in your order on a keyboard by your parking place as you get out of your car? You'd put your credit card in to pay and get a card to put that into a slot once inside. Your tray would come out almost immediately with your order. A similar system would work for the drive-through service. If you don't have a credit card you can pay with cash inside. But you can bet that McDonald's credit cards would be plentiful. They might even work at Wendy's, earning you prizes or future Big Macs.

Long Ago

When I first moved 73 to New Hampshire from Brooklyn in 1962, just two years after starting it, I hired a bunch of college dropout hams to come work for me. I paid $20 a week, plus room and board. I had up to eight hams living in my 40-room house and we had a great time. I cooked the meals, we put out the magazine, and we set up one heck of a ham station way up on Mt. Monadnock, a few miles away.

When I bought a small offset press we started also putting out a small VHF magazine, a contester's magazine, and one for club newsletter editors. High school kids came in after school and helped collate, staple, and

address these publications for 50¢ an hour. They got some spending money. It helped keep them out of trouble. And they got to learn about the responsibilities of working.

I had one ham working with us who was so much trouble that I finally gave up and tried to fire him. He pleaded with me to let him stay and keep working without any pay. Being a sucker, I said I'd give it a try. After a couple weeks I told him he wasn't worth nothing. He then offered to pay me $20 a week if I'd let him stay.

I finally agreed to let him stay if he'd live in my house up on the mountain and help clean out the brush around the place. Just don't come down and aggravate us here. Well, for instance, I did the cooking and the live-in hams took turns washing the dishes. When it was Tedsy's turn he managed to turn a half-hour job into a four-hour job. The same when it was his job to empty the wastebaskets or shovel out the horse stalls.

Tedsy came down from the mountain one day and asked if I minded if he put up a vee beam for six meters, aiming it down the east coast. What could go wrong? I said sure. The next thing I knew a few weeks later he'd cut down a couple dozen big trees to make a path for the two legs of his vee beam. Worse, he'd miscalculated a bit and the beam was actually aimed at Bermuda, so no one down the coast could hear him.

I remember him walking up with a broken yardstick in his hand. He looked at me sheepishly and explained that he'd had it in his mouth and walked through a 30" door.

Bless The League

One day the government arrived. They'd had a complaint about my paying less than the minimum wage. I pushed them to find out where the complaint had come from, and they said it was the ARRL in Connecticut. They said I'd have to stop paying the hams with the room and board and $20 a week, pay them regular wages, and charge them for the room and board. And the after-school kids would have to get at least the minimum wage.

I automated the collating and addressing of the publications I was printing, thus getting rid of the school kids. The hams were replaced by local people doing most of the work. No more room and board. No more fun. And without the gang to keep the ham shack up on the mountain operating, I closed it down and sold the place. Well, we all had the time of our lives while it lasted. Several of my alumni have gone on to be successful entrepreneurs.

You better believe that the lobbyists in Washington from Mexico and other low-wage countries are pushing congress hard to increase our minimum wage. Every dollar it goes up will mean millions for their countries, and more welfare and unemployment problems for us.

One alternative is to improve our school system so we'll have better educated and better skilled workers so we can compete better internationally, but here we're up against the most powerful lobbies in the country, the teacher's unions. And they're unfailingly supported by the mass ignorance and apathy of voters.

Say, if we move the minimum wage up to $15 an hour we'll no longer have any poverty, right? Who could possibly be against that? If they move it to $20 I might even consider working again.

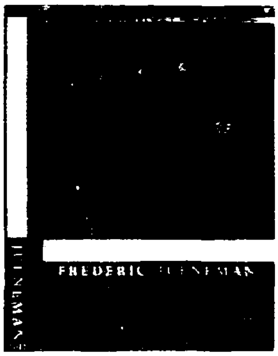
Teapot Tempests

The ham newsletters have been scraping the barrel lately. Like f'rinstance, the FCC, which has been refusing to issue special calls, got forced by the USIA into issuing one for the VOA's 50th anniversary: K3VOA. Sigh. And a judge awarded N5DA $10,000 from N5EWD for some names he was called over the local repeater. Oh yes, the West Coast IARN director quit after an abusive call from Baxter. And WA6ITF is pissed at Baxter for messing with his news reports. An average week.

With KV4FZ presumably QRT after his court conviction, I wonder how the mess he generated on 14.313 is progressing. I suppose there's no real hope of getting Congress to grant a special exemption from prosecution for blowing away the rest of the BARF gang. It's the lack of reasonable loopholes in our laws that are making the Mafia so successful. If we could attract some Sicilian hams, perhaps we could get our bands cleaned up. Lord knows the ARRL seems to have absolutely no interest whatever in the problem.

Rapture!

There's a new book out that I've just got to get you to read. How are you going to learn anything if you don't read? Instead of wasting big parts of your life on nonproductive amusement like watching ball games (of any kind), stupid TV crapola like sitcoms, game shows, soaps, and all that gawking OJ foofarah, pick up a book, a highlighter, and read.



You can read on buses, planes or trains, in the back seat if someone else is driving (Sherry drives—I read), and while waiting for your waiter in a restaurant (they're called "waiters," right?). You have the same 168 hours a week to work with that I do, and I'm polishing off a couple of books a week, and that's in addition to keeping up with around a hundred magazines a month. I'm no magician. I'm not doing anything that you couldn't do, if you wanted to. Now, what can I write that will get you off dead center? Dead is the operative word there.

For instance, if I can get you to (a) buy the book and then (b) actually read it, you're going to have the time of your life with Raptures of the Deep by Fred Jueneman. It's just out, but I got a sneak preview via a disk copy from Fred last year. Barnes & Noble estimate that 50% of the books they sell are never read. I'll bet it's more like 80%, from my experience in talking with people.

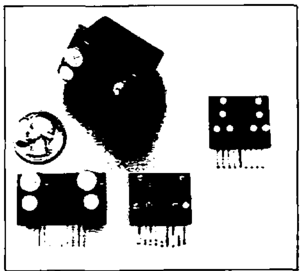
The sorry fact is that most people are not reading books. I was talking with a product of our local school system the other day and I asked her how many books she's read. Oh, about 15 in the last ten years. All fiction. Sigh. It's no wonder she's stuck in a low-paying job that requires few skills and little knowledge.

What's Raptures about? Well, it's nonfiction, and it's about what we understand in science today, and the challenges facing scientists in just about every field. Jueneman has done an incredible job of research on how and why scientists believe what they do about our world and how it works. And none of the usual math equations scientists don't seem to be able to help themselves from using (and make them seem brilliant). Oh, the egos in the Ph.D. fields! I know hundreds of Ph.D.s now, by virtue of my cold fusion adventure. Some are great fun to talk with, others can't help letting their egos show. That's a natural manifestation of insecurity (aka an overcompensated-for inferiority complex).

The "Raptures" of the title has to do with our living at the bottom of a sea of nitrogen (air is 78% nitrogen) and thus suffering from nitrogen narcosis (raptures of the deep, as experienced by divers who get too much of it).

To get an idea of the breath of the book, just look at the 12-page index in the back. Three columns per page! Fred has done a remarkable job of historical research in a surprising number of fields.

The book runs 286 pages, costs $30, and is published by Research and Development magazine, where many of the chapters originally appeared in Fred's columns, which he's been writing for them for over 20 years. Yes, I'll have the book available via Uncle Wayne's Bookshelf. ISBN # 1-57450-001-5. You can help Fred by pushing your local library to get a copy. It'll make a wonderful gift for a youngster who has learned to read, if you know any. 73



More tiny components from Sescom.

It's *your* brain, use it or lose it!

HOMING IN

Continued from page 72

accommodate standard two meter FM gear and to equalize the field. The four divisions were based on age only, not sex. Age brackets were determined Saturday night after sign-ups were complete. See the sidebar for a summary of the rules.

Sign-ups for the Sunday hunt were accepted all day Saturday at the convention hall. Upon registering, entrants received a sheet of rules and directions to the staging area. We were concerned that if they knew in advance exactly where the hunt would be, they would go there early to get the lay of the land. Besides giving some an unfair advantage, this would interrupt the fox hiding committee's work. So we pulled a switcheroo. The instructions told them to report to the Los Angeles Maritime Museum, two miles away from Angel's Gate Park. There they were met by a foxhunt committee representative. When all hunters had arrived, the group was told the actual hunt site and given directions to it.

Forty convention-goers signed up for the foxhunt, which sets a record for entries in a Southwestern Division Convention RDF contest. Ages ranged from 11 to 70. Two were non-hams and the rest were licensees of all classes. The hunt went smoothly and everyone had a great time. A wide variety of equipment was used, from sophisticated sniffers to simple "body shielding" maneuvers. Almost everyone found at least one transmitter. Five found them all.

I hope reading about Hamcon/Foxhunt-95 has inspired you to try international-style foxhunting in your home town and given you some ideas on how to do it and promote it. If your club has never done RDF contesting, it's an easy way to start the fun. If you have been doing mobile T-hunting for a while, it's a great change of pace. Who knows, a sports channel may make us all famous some day!

Next time, I'll have more on Hamcon/Foxhunt-95, including stories of two handicapped hams who participated. In the coming months, I'll tell how other groups here and abroad practice for international championships. You will also learn about transmitters and RDF setups that work best for this kind of hunting.

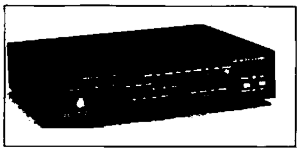
I want to hear all about RDF contests in your area, whether you do mobile T-hunting or on-foot foxhunting. Send your stories and photos to the address at the beginning of this article or send e-mail to me via Internet (Homingin@aol.com) or CompuServe (75236,2165).

(See Rules Summary page 81)

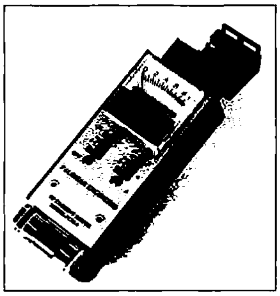
NEW PRODUCTS

Compiled by Ron Galik KA0AET

Radio Adventures Corp. has released the C5 advanced CMOS Frequency Counter chip. The C5 delivers many unique and useful features in a 28 pin DIP. The C5 along with a standard 74HC02 and three low cost driver transistors drives a six digit seven segment LED display to 100 Hz resolution. Frequency range is DC to beyond 50 MHz and the update rate is approximately 40 times per second making the display update appear almost instantaneous. The C5 can be used to build general purpose frequency counters and is especially useful in building frequency displays for home-brew. transceivers or to add a display to vintage tube type equipment.

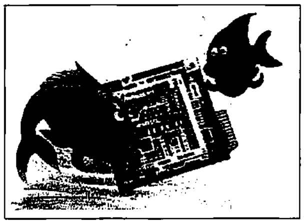


Advanced Electronic Applications, Inc. has released the PK-232MBX and PK-900 multi-mode data controllers are now shipping with Global Positioning Satellite system (GPS) firmware. The biggest new feature is that GPS commands can be remotely programmed. so in Stand Alone Tracking applications where a TNC. GPS receiver. and radio (no computer) are installed in a vehicle—it is all done remotely. The data controllers automatically transmit their position information at user-defined intervals and can also be remotely polled for GPS location information. This remote polling is great for those who use the TNCs in a Pete Bros. ULTIMETER-II™ weather set-up. Each member of an amateur radio group in a region can set up a weather station in the back yard, then other members can poll (at any time) the various weather stations for information. Doing this forms a picture of the region's weather on the Automatic Packet Reporting System map (APRS ™, by Bob Bruninga). Mobile packet users can be transmitting their position information in a Stand Alone Tracking configuration and still act as a message forwarding mailbox—all while mobile.



Palomar Engineers model PCM-1 RF Current Meter

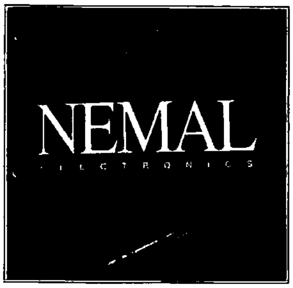
Palomar's new clamp-on RF current meter makes it possible to check ground radials one by one to find broken radials and to determine antenna efficiency. It also checks currents on coaxial cable shields. It fits any wire from the smallest to f(1.2)" in diameter. It has three ranges: 0.1, 1 and 5 amperes full scale with direct panel meter readout. It is compact, handheld, battery operated for use right at your antenna—no other equipment is required.



AMTECH has released three SMT solder creams for working with surface mount components. The NC 500 series eliminates solder balls and is a halide- Halogen- and. VOC-free.

The WS 400 series is water washable and non-hygroscopic. The FRS series is fatigue resistant at.

New Product reviews and reviewers are welcome. Write to Ron at 73.



NEMAL Electronics has published a new edition of its cable and connector selection guide. The 48 page guide contains detailed technical specifications and illustrations of more than 1000 cable, connector, and interconnect products. The 1995/96 edition contains more than 100 new products including a section on 75Ω BNC connectors, adapters, and patch panels for serial digital; applications. RF terminations and attenuators. and custom composite cables. The guide also includes comprehensive performance data on a wide range of coaxial cables together with charts for quick selection of appropriate connectors and tooling.

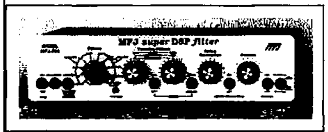

SPA-20A.

AVCOM has also introduced a super portable spectrum analyzer, model SPA-20A. It tums any TV into a powerful 950-2050 MHz spectrum analyzer. allowing the user to find and identify satellite signals, maximize antenna performance, and troubleshoot system failures.

AVCOM has just released the PRC-1 Polarotrol Control Box—a self-contained. battery powered. microprocessor based controller that can control servo-actuated feedhoms or other satellite ham equipment.

AVCOM's PSA-65B portable spectrum analyzer covers frequencies from less than 1 MHz to 1250 MHz and has greater than -95 dBm sensitivity. The lightweight. battery or line operated instrument is perfect for field testing RF systems.


PRC-1



The MFJ-784 DSP Filter has a tunable "brick wall" bandpass, lowpass, highpass, notch filters, programmable pre-set filters and up to 60 dB attenuation. The multiple notch filter eliminates heterodynes. adaptive noise reduction reduces noise. and QRN for voice. CW. and data. It comes with 2 watt amplifier, volume control. input level control. speaker jack. earphone jack. accessory jack. PTT line and PTT sense and line level output. It measures 9" X 2f(1.2)" X 6". It runs on 12 VDC or 110 VAC.

MFJ-452 Super CW Keyboard

MFJ Enterprises, Inc. announces the MFJ-452 Super CW Keyboard with *Perpetual Memory.* This keyboard has a two line LCD display and RFI suppression.

The MFJ-452 features eight 250 character nonvolatile message memories. a 150 character type-ahead buffer. an iambic keyer. and a powerful *Morse Code Trainer*, plus other features.

MFJ-1798 "10" Band Antenna

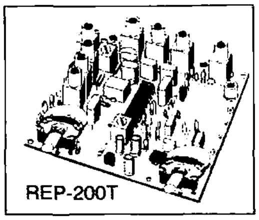
The new MFJ-1798 is a "perfect 10!" /ten bands that is: 75/80, 40, 30, 20, 17, 15, 12, 10, 6, and 2 meters with only one antenna. This antenna offers separate full size radiators, end loading, elevated top feed, low radiation angle, very wide bandwidth. It's self-supporting and only 20 feet tall. It will mount easily to any ground level spot, tower top. condo, roof top—just about anywhere! The MFJ-1798 is as easy as A B C to tune. The frequency adjustments are nearly independent—adjusting just one band has a minimum effect on the resonant frequency of other bands.

ACCULEX

ACCULEX has released a new catalog containing new digital panel meters, counters, timers, signal conditioners, printer cables and other accessories.

Addresses and phone numbers for these fine products can be found on their ads in 73 or by writing 73's Review Department or by calling 603-924-0058.

Continued on page 80



REP-200T

New Hamtronics® Repeater Models

The popular Hamtronics® line of VHF and UHF FM Repeaters has always offered high quality and more features at a reasonable price. Now the line has been expanded to include some very interesting new models.

The new REP-200T Repeater has all the features of the standard, microprocessor-controlled, REP-200 Repeater with the addition of a new DVR-3 Voice Digital Recorder Module. This allows messages to be *recorded off the air remotely,* using the microphone on any transceiver. It is no longer necessary to use a microphone attached to the repeater to record messages. DTMF commands control the record and playback modes. Thus, the control operator can change the message at any time, and repeater users can also request a playback at any time.

These new features allow the REP-200T to be used for club announcements or warning messages in addition to use as a voice ID, thereby playing the announcement periodically. If desired, the repeater can even use a CW ID, and its voice recorder can be used independently just to play messages on request. These new features don't add much to the cost of a repeater, either. The REP-200T is $1145 in kit form and only $1395 wired/tested.

With the availability of low-cost digital voice recorders, Hamtronics also has developed an economy repeater with a voice ID built in. The new REP-200C Repeater uses a new COR-6 controller module with voice ID but no DTMF decoder or autopatch. This will be especially welcomed by those wishing to put a repeater on the air which is more user friendly for no-code hams to use. It saves a considerable amount of money, too. The REP-200C is only $795 in kit form and $1095 wired/tested.

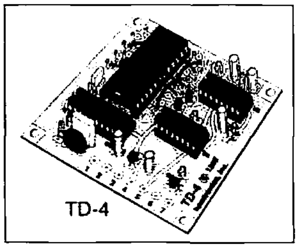
All the above repeaters are available for 6 meter, 2 meter, 222 MHz, and 440 MHz ham bands; and they are FCC type accepted for operation in the commercial hi-band and UHF band. Basic output power levels are offered from 10W to 25W.

Voice-ID Repeater Controller

The new COR-6 module from Hamtronics combines COR circuits and a real-voice ID on one board. It can be used with transmitter and receiver modules to make a simple, low-cost repeater.

A digital IC records up to 20 seconds of your voice, using audio from the repeater receiver. The unit includes tail and time-out timers, courtesy beep, solid-state relay to key transmitter.

The 20 seconds of recording time can be broken up any way you like. You can enhance the basic circuitry by adding a switch to select any of several messages, for instance. You can even use the TD-4 DTMF Controller to allow remote control of recording.



TD-4

With a kit price of only $99, the COR-6 is quite a bargain, considering what voice ID cost to implement just a few years ago. It is also available wired and tested for $149.

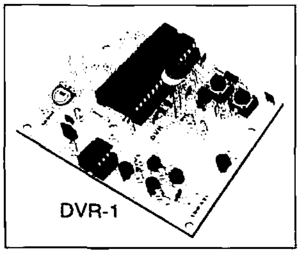
New Hamtronics® VHF FM Receivers

Hamtronics, Inc. has announced new low-cost monitor receiver kits for the 28, 50, 73, 144, 152, and 220 MHz bands. The R100 Receiver was designed to replace both the R144/R220 and R76 series receivers which have long been popular for demanding applications, such as repeaters, audio and data links, packet radio, and remote control. The R100 not only provides a replacement for the older R76 series used for the lower VHF bands, but it also allows easier coverage of the various segments of the 150-175 MHz high band and 200-240 MHz ranges which are popular with commercial customers. In addition, the R100 was designed to have a new positive-acting, wide-range squelch circuit and additional output terminals for repeater audio and discriminator audio, and it is now easier to assemble and align.

The R100 retains all of the popular features Hamtronics receivers have been noted for. It uses triple-tuned circuits in the front end and excellent crystal and ceramic filters in the IF with steep skirts for close channel spacing or repeater operation. The IF selectivity, for instance, is over 100 dB at +/- 12 kHz away from the carrier. Low noise FETs in the front end provide good overload resistance and 0.15µV sensitivity.

Best of all, the price of the R100 is considerably less than the R144/R220 series. Kits for any of the bands are only $129. Wired and tested units are only $189, a $30 savings. Channel crystals for any desired frequency within these bands are only $12, which is a very good price for commercial-grade crystals. Proportionally-controlled crystal ovens are available for operation over wide temperature ranges.

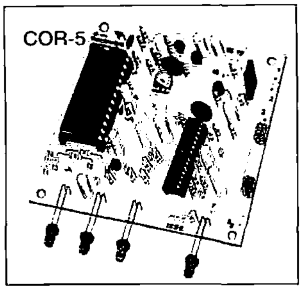
For more details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535 or call (716) 392-9430 (fax: (716) 392-9420). While you are at it, ask for a complete catalog, which also includes all their equipment, including repeaters, transmitters, receivers, transmitting and receiving converters, preamps, and data modems. (Be sure to tell them where you heard about this.)



DVR-1

New Hamtronics® Digital Voice Recorder

The DVR-1 Digital voice Recorder is a versatile PC board module, which is designed primarily as a voice ID'er for repeaters. But it also provides features so that it can be used as a contest CQ caller or as a "radio notepad" to record short parts of received transmissions for instant recall.



COR-5

As a repeater ID'er, the DVR-1 module will record your voice, using either the built-in microphone or an external mike. It can be used with almost any repeater COR module, including the Hamtronics® COR-3, COR-4, and COR-5 (used in the REP-200 Repeater).

As a contest annunciator, you can record a message or even several messages. Eliminate fatigue or strained voice working contests or DX! Connect the audio output to the microphone input of any transmitter. Play your message back at the press of a switch. Unlike a tape, you don't have to wind back to the start; the voice ID chip in the DVR-1 automatically queues up the message you select.

As a radio notepad, you can keep the DVR-1 module wired to the audio output of a receiver ready to record up to 20 seconds of anything you might want to recall later. Say you are operating a contest or DX and want to be sure you catch the call letters or other information you hear. Simply hold down the record button to make a recording. Pay it back as many times as you like until you are able to make out information others lose in the QRM! The DVR-1 unit can directly drive a small external speaker for applications such as this.

You can also use the DVR-1 to generate a voice message used with a transmitter for fox hunts.

The DVR-1 module is an economical PC board which has recently been reduced in price. It can be purchased either in kit form at $59 or as a wired and tested unit at $99. It includes a small electret microphone and push buttons for record and playback.

Continued on page 84

Continued from page 78

Hamcon/Foxhunt-95 Rules Summary

1. Bring your own RDF gear, spare batteries, compass, protractor, pencil, water, medications, sunscreen, etc. When you arrive, stow your RDF gear in the impound area. Do not turn it on until you reach the end of the start corridor.

2. You will be given an official topographical map of the course to keep and mark up. The course boundaries are marked with green. Forbidden zones (church and Young Marines barracks) are marked with pink.

3. There are six FM transmitters with distinctive MCW ID, all on 146.565 MHz. Antennas may be any polarization. There is a non-scored intermittent beacon at the finish on 145.725 MHz. Do not transmit on any band while you hunt, except you may call for emergency assistance on 145.725 MHz.

4. Your starting time will be given to you in advance. Starting is at two-minute intervals. Contestants in different divisions may be started simultaneously.

5. Age divisions are as follows: Youth (17 and under) Prime (18 through 30) Masters (31 through 45) Seniors (46 and up).

6. Cash prizes in each division will be $50 for first place, $30 for second, $20 for third, $15 for fourth, $10 for fifth. Trophies will also be given for first, second and third places, ribbons for fourth and fifth.

7. You may find foxes in any order. Mark your card with the special punch near each fox. Foxes may be camouflaged. Look carefully for the punch, which will be attached close by. Make sure you punch the right fox number on your card; incorrect punches do not count. If you lose your card, you will be disqualified.

8. You must reach the finish line within 120 minutes after you begin, or be disqualified. Once across the finish line, do not go back onto the course.

9. There is no team competition. Each contestant hunts as an individual and may not accept help from anyone. Non-hunting guests must arrive at the venue with you and remain in the start or finish areas. Any contestant communicating by any means while on the course will be disqualified. Exceptions are for emergency medical assistance and discussions with official Hamcon/Foxhunt-95 Course Marshals, who will be wearing white ribbons.

10. This is an on-foot hunt. You may not use any wheeled conveyances such as bicycles, skateboards, etc. You may not hitchhike. Watch your step, as there are obstacles on paths. There may be wildlife such as skunks and snakes in the park.

11. We are here for fun. There must not be any unsportsmanlike conduct. Disturbing or damaging transmitters, antennas, or punches will result in disqualification. Decisions of judges are final.

Other rules and directions are covered in the text. For the unabridged Hamcon/Foxhunt-95 rules, send an e-mail request to Homingin@aol.com or send a self-addressed stamped envelope to the author.

SPECIAL EVENTS

DEC 2

FARIBAULT, MN The Annual Courage Center Handi-Ham Winter Hamfest will be held at the Eagles Club, starting with registration at 8:30 AM. There will be a Handi-Ham equipment Auction, Flea Market, dinner at noon, and Program. Talk-in on 19/79. Contact *Don Franz W0FIT, 1114 Frank Ave., Albert Lea MN 56007.*

JACKSONVILLE, IL The Central Illinois Winter Superfest, co-sponsored by Illinois Valley ARC and Jacksonville ARS, will be held 8 AM-2 PM at Turner J.H.S., 664 S. Lincoln Ave. Set-up at 6 AM. Flea Market, radio and computer dealers. VE Exams 10 AM; pre- reg. required. Contact Tim Childers KB9FBI, 773 E. College, Jacksonville IL 62650. Tel. (217) 245-2061. Talk-in on 146.775(-) and 444.675(+). Advance reservations taken until Nov. 15th. Send SASE with check payable to *Jacksonville ARS,* to *Rich Tavender KB9IXO, 721 E. State, Jacksonville IL 62650.*

MESA, AZ The Superstition ARC Hamfest will be held at Mesa Community College beginning at 7 AM. VE Exams reg. at 7:30 AM-11:30 AM. You must have original and one copy of your license and/or any applicable C.S.C.E. Photo ID required. Walk- ins only. Call *Larry Kuck, (602) 986-2298.* Talk-in 147.12(+) and 449.60 MHz. No PL tone required. Contact *Rick Checketts KA0KZB, (602) 898-9158; Edward Cole KB7RMO, 5264 East Hannibal St., Mesa AZ 85205*; or *Gary Roberts KB7VCP, (602) 461-0644.*

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

SPECIAL EVENT STATIONS

DEC 2-4

HOUSTON, TX Members of Clear Lake ARC and Bay Area QCWA Chapter 184 will operate SE Stations to celebrate the end of Hurricane Season for 1995. The Hurricane Party II Special Event will last 48 hours, 0000Z Dec. 2nd-0000Z Dec. 4th. Operation will be in the General Class portion of the HF bands, and on the CLARC Rptr. at 442.75 MHz. In addition to member stations, CLARC club station KC5NZF will operate in a mini Field Day. For a certificate/QSL, send OSL and a 9"" x 12"" SASE addressed to the station worked.

DEC 3 & 7

MESA, AZ EVARG will operate KE7PE 1400Z-2400Z Dec. 3rd and 7th, to commemorate the sinking of the USS Arizona. Operation will be in the lower portion of 20 meters. For a certificate, send a 9"" x 12"" SASE to *EVARG, P.O. Box 1424, Gilbert AZ 85299-1424.*

DEC 16

CONWAY, SC The Grand Strand ARC will operate WD4JMT 1400Z-2400Z in conjunction with the Conway Christmas Parade and Christmas Boat Parade. Operation will be lower General 80-15 meters and Novice 10 meters. For a certificate, contact *Dave Berry KE4OOW, 100 Longwood Ln., Conway SC 29527.*

DEC 16-17

Nazareth and Bethlehem, PA The Delaware-Lehigh ARC will operate the 1995 W3OK Christmas Cities station, 1400Z-0200Z, on 3.965, 7.265, 14.265, 21.365, 28.365. For a certificate, send QSL and a 9"" x 12"" SASE to *DLARC, RR 4, Greystone Building, Nazareth PA 18064.*

Hey, we need good potential cover photos!

LETTERS

Continued from page 6

around noon GMT. *We could use some of that in the US—Wayne.*

John McGowan Once again, KUDOS! Loved the story in Homing In re: tracking false SOS. I started reading your mag about a year ago. I was intrigued by the how-to antenna articles. I've been working in the cellular industry for the past 8 years. As you might guess, antennas seem to be the most vital link in ther chain. I hadn't been involved with ham radio since Boy Scouts, 30 years ago. Well your editorials have piqued my interest again. I've studied the no-code test backwards and forwards. But now comes the problem; where to take the test? I understand that most clubs have VEs, but you'd think the identity of local clubs was a state secret! I've a suggestion for your Special Events column—a posting for clubs. *Sure, why not?*

Don Shipman W3RDF. I read the article entitled "Senior Citizens Upgrade" by Hal Goodman W3UWH in the October issue of *73*. I couldn't help but reminisce about the value and meaning of the top ticket in the days when the author and I got started in this great hobby. In those days the Class A or Extra Class ticket carried honor and prestige and not just the privilege of using more frequency spectrum. Today it lacks the honor and prestige it had in the 40s, 50's and 60's. I recall looking up to Class A hams with a great deal of admiration and respect for their knowledge and true accomplishments. They were the real king pins of our hobby. Not so today. Most are "Extra" in name only and know little about radio theory and are in many cases very poor operators.

Like the author, I got my first license (Class B) in 1950, before the Novice Class was created. I sat in front of the FCC inspector shaking as I waited to see if I passed the 13 wpm code test, then waiting weeks to find out if I passed the written exam. There wasn't a published "question pool" to memorize. There was no "multiple choice" code test. Also like the author, my, family and career were the primary focus of my life and I gave little thought to upgrading until I retired in the mid 1980's. The freedom of retirement provided the time to upgrade to Extra; to become a VE and an Elmer and to enjoy the satisfaction that comes from helping others.

For the past three decades our permissive society has allowed our standards to erode in all walks of life. Kids graduate from high schools without knowing how to read or write. Unqualified people are placed in positions of authority simply to meet quotas and goals, without regard for their ability. Standards in our own hobby have been lowered, making it easy for someone to memorize their way into the ranks of the heroes of the past. It's really sad that many of these Novice Extras, deceived by the pride of their new title, will never strive to understand one tenth of the theory they were forced to memorize. This false sense of accomplishment will most likely quench their desire to become the real Extras they might have otherwise become.

The author made a lot of good arguments for the case of license entitlements partly based on longevity. I believe if his friends really wanted the top ticket they could easily put forth the effort to upgrade. Furthermore, I think his proposal represents another step in the wrong direction of putting people into higher positions when they're not really qualified. Let's not further lower the standards simply to accommodate a certain class of people. The country is beginning to recover from these errors of the past and its time our hobby did the same. *Oh, I agree with you. But then what do you suggest we do to generate the five million hams we need if we are going to have a prayer of holding our frequencies? Wayne.*

Mike Snowden KE6HVH Hello to all at 73: First of all I wish to thank all of you at *73 Amateur Radio Today* for a great publication. "Uncle Wayne" has certainly opened my eyes as well as my mind. If only I had found him a few years back. But then as he infers, "it is never too late to start."

I am a "newbie" to amateur radio, just over a year now. Since I have started reading *73*, Wayne

Continued on page 85

Number 83 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Conditions this month will range from very good to poor and very poor. You may expect the Very Good conditions between the 5th and 7th, and again between the 21st to 24th, with Good a day or so on either side. The Poorest days are expected to be the 14th to 17th, and 28th to 31st. The remainder should be Fair or trending.

10-12 Meters

An occasional F_2 opening toward the tropics during daylight hours . . . but, as is usual during sunspot minima, you can't expect much winter activity. Listen and call on the Good (G) or Very Good (VG) days.

15-17 Meters

Short skip and some DX openings during daylight hours on Good (G) and Very Good (VG) days, particularly during afternoon hours. The band closes early, however.

20 Meters

Fair to good DX during daylight hours, peaking shortly after sunrise for an hour or so, and again in the early afternoon; and closing at, or shortly after sunset. Short-skip up to 2,500 miles or so during daylight hours. Again, listen on the Good and Very Good days. Check WWV at 18 minutes after any hour.

30 Meters

A strange and unpredictable band! Sometimes like 40 and other times like 20. Your best bet for DX is late afternoon and early evening hours. Short skip during daylight hours will prevail.

40 Meters

DX to Europe and Africa during late afternoon and toward South America after sunset. After midnight, listen for Asia and the Pacific. Short skip during days and longer skip after dark.

80 meters

This should be your best DX band during hours of darkness, peaking around midnight and just before dawn. Short skip in daytime and longer skip after dark.

160 Meters

Here's another wintertime DX band. Open after sunset, and peaking to the *east* around midnight, and toward the west and Pacific areas near dawn. Band closes during daylight hours due to high absorption of these lower HF frequencies.*

For those who chase DX, you will become avid and frequent listeners and *not* callers. Hover around the band's lower edges on the lower HF bands, and almost anywhere on the higher HF bands. As always, have fun and stay sharp. Let me know how the forecasts work for you . . . and *have a wonderful and happy holiday season.* W1XU

*A vertical antenna is superb for transmitting and fair for listening. How about using one with *both* vertical and horizontal radiation? I'd suggest a vertical loop, switchable from bottom to side feed points if you can have only *one* antenna.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15[1]	15[1]
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15[1]	15[1]
INDIA	20/40[1]					20[1]	40[1]	20[1]				15[1]
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40[1]	40[1]				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	60	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15[1]	20[1]	20[1]				40[1]	20[1]	20[1]			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R.	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*						20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40[1]	40[1]							15	15	20
U.S.S.R.		40[1]	40[1]	40[1]	40[1]				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

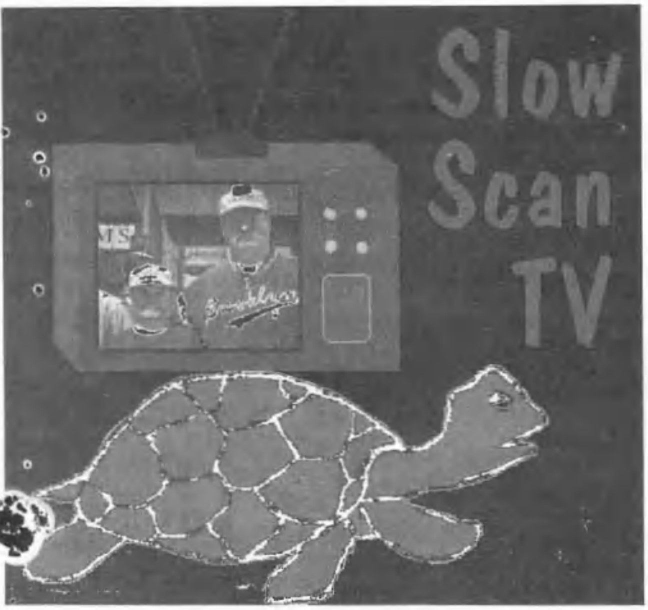
1Chock next higher band
*Bp-Meters possible on good days only

DECEMBER 1995

SUN	MON	TUE	WED	THU	FRI	SAT
					1 F	2 F-G
3 G	4 G	5 VG	6 VG	7 VG-G	8 G	9 G-F
10 G-F	11 G-F	12 G-F	13 F	14 F-P	15 P	16 P
17 P	18 P-F	19 F-G	20 G	21G-VG	22 VG	23 VG
24VG-G	25 G-F	26 F	27 F-P	28 P	29P-VP	30 VP
31VP-P						

NEW PRODUCTS

Continued from page 80



FREE Slow Scan TV

Slow Scan TV is one of the most fascinating yet often neglected facets of Amateur Radio. Most people think it is poor quality black & white images using equipment costing kilobucks. That *was* true but isn't anymore.

John Langner WB2OSZ has written an interesting handbook containing sections on:

- How to get started
- Questions and answers
- Typical color images
- Commercial products
- Home-brew projects
- Much, much more

It is available for *free* in electronic form on the World Wide Web. The Universal Resource Locator (URL) is: http://www.ultranet.com/~sstv Contact John Langer WB2OSZ john@world.std.com 115 Stedman St, Chelmsford MA 01824-1823 (508)-256-6907

Addresses and phone numbers for these fine products can be found on their ads in 73 or by writing 73's Review Department or by calling 603-924-0058

Advance Design

Advance Design has just introduced the CK-53 Morse code monitor/keyer module. This unique product along with a PC and a radio allow the user to tune in the world of CW. The CK-53 is an assembled and tested, 2.5" X 3" PCB assembly which features an RS-232 interface to the computer, dual parallel speaker connections for audio, and an isolated relay contact keyer output.

The included terminal software allows easy, convenient communications. Eight buffers in addition to the 512 byte transmit buffer can be edited before transmission, either manually or by appending saved buffer data logged to disk allowing the user to save favorite QSOs.

Old West Graphics

Old West Graphics is happy to announce the release of Photo ID Name Tags for clubs involved in ARES, RACES, SKYWARN, SSC, and NTS. Professionally produce, these tags are 2.25" wide by 4" high, heat-laminated, with a 3" strap and alligator clip for you lapel. Official reps of local groups are the only people eligible to place orders, since these are law-enforcement-recognized identification. Each tag is $5 plus 30 cents shipping and handling. Write for the Photo ID Package, which contains all necessary information and a sample.

While you're at it, request Old West Graphics latest sign catalog and get a free surprise gift. Old West does t-shirts, custom ham radio street signs, sweatshirts, decals, banners . . . anything and anywhere you'd want your club logo or callsign. Latest product is a 4" by 8" hamshack callSIGN for $5.00.

New Product reviews and reviewers are welcome. Write to Ron at 73.

U.S. Repeater MapBook

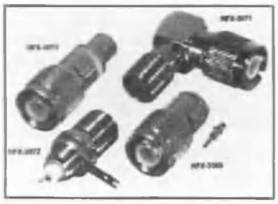
If you do any traveling you want to know where to find the local repeaters and what, if any tones it takes to use them. Artsci has a 147-page book of maps showing the locations of the open repeaters in the US, Canada, and Mexico. It also includes a CD-ROM data-base. And all this for only $29.95 from your local dealer, or direct from Artsci, Box 1428, Burbank CA 91507. Phone 818-843-4080.

Collins Amateur Equipment

For $22.95 pp you can get a nicely done 104-page 3.5" x 7" guide to Collins equipment made from 1946 to 1980. Well, almost all of it was made between 1946 and 1962, when the ARRL's so-called "Incentive Licensing" proposal put most of their dealers out of business, along with over 90% of the other manufacturers. Collins-lovers will enjoy this guide.

Free cable to connector cross reference

RF Industries announces the availability of a *free* Belden-Alpha-Times/RFI cable to connector cross reference guide. The guide enables you to easily select the appropriate RF connector to match the cable you are working with. The catalog is organized first by cable groups and second by the types of RF connectors available for these groups. The connectors are then divided into subgroups by type. The catalog is *free*

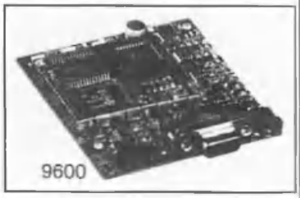


RF Industries announces the availability of FCC certified connectors.

According to the FCC, under certain applications it is illegal to replace a slock antenna with one that provides higher gain. In order to prevent this from happening, the FCC has issued an edict that calls for a unique connector thereby prohibiting the attachment of any other type of connector.

These connectors, which appear to be TNC but in actuality are not, comply with the guidelines set forth in FCC regulations. The 4 connectors include a male clamp for RF-174/316 (RFX-3059), antenna mount (RFX-3070), a right angle male to female adapter (RFX-3071), and a female bulkhead (RFX-3072).

NEUMOD 9600 High Speed MODEM



The NeuMod 9600 is a high speed, 9600 bps "Smart" modem designed to improve the quality and reliability of data communications over narrow band radio links. Its advanced protocol provides for 255 unique ID codes network configuration for both selective polling and/or group polling. Data transmission is either transparent or packetized, each packet is appended with both a source and destination ID code allowing point to point or point to multi-point of up to 255 points. When the NeuMod 9600 is integrated with the DCL-SYNX-U, it becomes NEULINK 9600, high speed "Smart" 2 watt modem transceiver.

Continued from page 82

has reminded me that there is more to amateur radio than slapping down a credit card to buy amateur radio gear. He reminded me of my father K6YPB, now a silent key, who was forever burning up the solder when I was a kid. He was always building something. I only wish it had not taken me 37 years to discover those same joys.

I do not have the electronic education he and others have, so I am like a new born, learning as I go. I joined a radio club in hopes to get "educated," but as it turns out, most have the same void as I do. Wayne taught me to quit sitting back and waiting for others. I had done some reading, and picked a topic of interest to the members and began to learn. I have put together two antenna-building parties and the next will be a soldering party. I have never experienced the type of satisfaction I get by helping others to build a project with their hands, and them being able to see and use the fruits of their labor. It is a wonderful feeling. Thank you Wayne.

This entire project was inspired by Wayne. It is my small attempt to help bring back the somewhat lost art of home-brew. With the exception of the 10 meter vertical, I built everything. The array consists of two 2 meter quagis phased together, two 70 CM quagis phased together, a 6-foot 440 MHz dish, a 23 CM and a 70 CM vertical. The tower is a 40-foot crank-up home-brew. The AZ/EL is controlled by surplus home TVRO satellite parts. The dish and quagis all move together in both AZ/EL for amateur satellite work. The whole works was brought up to a mountain top camp site for a club field day event last June. We had 80 members show up and we all learned and had a great time.

Thank you for *73 Amateur Radio Today.*

Rickey Nievera N2MBC Newcomers to amateur radio might want to know about a way they can work DX via 2m. Talk about radio fun! I'm using an Alinco Data Radio with an old Amiga 2000 and the MFJ 1278B TNC with the MFJ 1290 Multicom software and having fun with packet, working DX via the Internet. Here's what I do. I connect first to a local node and then to an Internet Gateway like N2MH-11, which is more than 50 miles away. At the prompt, I'm on the Internet. I type "/Who" and a long list of DX stations are listed, including a couple from Australia! It can take a long time to get through on the busier nodes, but there are a lot of channels, so you can move off for a private contact. Digital modes are here!

Ted Brattstrom NH6YK/KC6YK Just back from Palau and got caught up with the last few months of *73* and *Radio Fun*. OK, I'll attempt some articles for you on the joy of satellites and mini-DXpeditions (KC6YK—NH6YK/KH4—NH6YK/Kalawao County—NH6YK/ZL). However, I'd like to make one complaint, you've been bashing Techs lately and suggesting that they are not full members in the ham community since they are not operating on HF. Granted, many people stop at 2 meter repeaters (others seem to have stopped at 75m or 40m phone), *but* some of us use the satellites and not only work some great DX, but also have had some very interesting conversations. Of course the other modes are also fun. I've operated packet, TCP/IP, 6m, RS-10, AO-21, FO-20, RS-15, MIR, a bunch of shuttles (packet and voice for both spacecraft types), AO-10, AO-13. So the thing to do is to kick them into really using the spectrum they/we have access to. Granted, HF is fun too! As a Tech+ I've played on 10m phone and received my DXCC, but I've also had some great chats, such as an hour and a half with Trent Christian on Pitcairn. The path to North America closed for him, but he was strong into Hawaii, and we kept finding things to talk about. Then again, I've had exciting, if short, 10-minute chats with U5MIR, U3MIR, and Norm Thaggard (RØMIR). It doesn't take high power if there aren't other hams trying to contact them! And I've helped set up a SAREX contact with students from my school and another school. We had lots of fun with that! We simulcast it on the statewide RACES linked repeater system. Some hams and SWL (VHFLs?) got their first taste of space communications listening in! (Hmmm, do you want an article on that?) Alas, in almost five years of hamming, I've only convinced about 12 people to get their licenses. I ought to be getting way more than that since I am a high school chemistry teacher. But I definitely have added an awareness of radio to my students and colleagues. I'll have to grab that list of ham activities you wrote about and see how I do. I know I haven't worked DXCC in a weekend or done EME/ATV/Aurora, but I've been working at EME, and we are too far south for aurora, and drat, I'm always overseas playing when the Hawaii to West Coast duct is open. I wasn't too active in Palau this summer. The kayaking, diving, and snorkeling were fine, but the bands weren't in good shape. I operated 20M SSB and RTTY (my privileges in Palau are better than in the US!) as well as OSCAR 10 and 13. It was depressing to hear European stations calling CQ at S5 levels on 20M and then not to be heard by them. At least I made a few contacts with South America.

Ted, we've got 250,000 Techs and they're not *going for their General Class licenses, so I'm going to keep right on bashing until I see some results. Sure, the code is a nuisance, but we've got kids seven years old with their Extra Class tickets, so unless someone is seriously mentally challenged (as they put it these days), they can learn the damned code. Wayne*

Don Lakenmacher N5UNU On Field Day, my wife AB5RI and I were driving through Wyoming on vacation. We were using a Yaesu 757GX into a 6-foot mag-mounted Outbacker. My wife was driving while I was working a W2 on 20 meters. We were moving along at about 60 mph when suddenly we were hit by a blast of wind which knocked the antenna off the top of the Suburban. She pulled over as soon as she could, but the antenna was dragged quite a ways. I checked the damage: a big dent in the side of the car, a ground-up mag mount, sans magnets, and a well-traveled Outbacker with only half of its stinger and lots of new character marks. But the W2 was still coming through nicely and the antenna still works just fine. Tough rascal.

Steve Loritz KC7COI After reading your editorials for the past three years and coming across two back issues from the mid-seventies at the used bookstore I work at, I am compelled to write you.

I've been interested in cold fusion since reading about it in your editorials and (surprise!) not reading about it anywhere else. Unfortunately, my local library is a bit anemic in the information department so I'll ask you where I can find more information. Some time ago I ran across a copy of your *"Cold Fusion"* magazine at a bookstore, but could not afford the stiff cover price. Be that as it may, my wife and I are very interested in taking advantage of getting In on the ground floor of this tremendous opportunity. Can you help us? Your guidance would be most appreciated.

A couple of other things to pass along to you and anyone else: I have been reading a couple of books that those subscribers to *73* who still read might like to take a look at. The first is Joel Barker's *Future Edge*, published by William Morrow and Co., New York, ISBN 0-688-10936-5. Joel's book will help you be ready for opportunities that will arise in the future and, if you are willing to turn off the TV and get up and do something, give you the tools for success. This book deals with recognizing the paradigms that people and industry have been slaves to when paradigm paralysis sets in and holds them down while those whose anticipation of change, innovative thinking, and drive for excellence causes them to pick up the ball and run. A few examples are in order: digital watches, microcomputers, small energy-efficient cars, total quality management, et al. There is no secret to the success of the leaders in these fields—just an open mind.

Book number two, *The McDougall Plan* by John A. McDougall MD, published by New Century Publishers, Inc., ISBN 0-8329-0289-6. This book is all about health-supporting diet and lifestyle. If you're tired of paying your doctor a king's ransom for outdated, often food-industry driven false information designed to support him and the pharmaceutical industries, read this eye-opener. It will help you feel better, look better, get your colon regular and allow your body's ability to heal itself save you time, aggravation, and money. John's book exposes the fairy tales that our school system and the food/health industry have been propagating for decades. Wait until you

Continued on page 88

LETTERS

Continued from page 85

read about how our culture's acceptance of rich foods like meat and dairy as the cornerstone of diet have led to increased disease rates, cancer, fat kids, poor tests scores, lower intelligence . . . and on, and on, and on. Why do you think people with starch-based, health-supporting diets like those in Asia, the Middle-East, and elsewhere have lower cancer and disease rates, smarter kids, and longer life expectancy?

Enough of that. Wayne, we are having a hard time putting ideas to action. What will it take to get everyone going? Thanks a million.

Steve, I've been trying to get the old duffer hams off their fat butts and into new technologies for 44 years now, so I doubt that your letter will break many away from Gilligan's Island re-runs, or spending hours checking into 75m nets to report no traffic. Wayne

Luke Gow VK2GXQ My name is Luke and I am a 14-year-old high school student in NSW, Australia. Although I have only been on a short time I have been very active on the ham bands. I hold the 'Full Call' license which is the highest of the four Australian classes and I may work all modes and all bands. My Dad is also a ham and we are both constant readers of *73 Magazine*, although the issues are a couple of months behind because of shipping to VK. I designed my own QSL card which I have included for you, perhaps you may consider it for QSL of the Month. I drew both the koala and kangaroo freehand before scanning it with my "Typist" Caere Scanner so I could edit the pictures on my Apple Macintosh LC computer. After editing the Koala and Kangaroo, I added clothes to the animals. The kangaroo's shirt bears "VK" for Australia. As my two major interests, besides amateur radio, are surfing and playing guitar, I decided to include a surfboard and Gibson guitar on the card also. The koala is standing with the surfboard in the sand, while the kangaroo is holding the guitar and a flag in his hands. The flag shows a basic map of Australia and has been colored green and gold, Australia's national colors. I then colored the animals using Pixel Paint, a Macintosh paint program. After setting the text I printed the finished card on my Deskwriter C Inkjet printer. I enjoy working the states and in the three months I have been on the air I have worked 46 states and have 33 confirmed. I am only waiting on Maine, Delaware, North Dakota, and Idaho to contact. The whole family enjoys reading the magazine, keep up the good work.

Rusty Chamberlin WA5PDG. I first subscribed to *73* when I was a junion at LaFeria High School (Texas), over 30 years ago. You are truly an inspiration. Your curiosity, your optimism, your belief in the Individual, and your belief in free markets inspires many of us. Keep up the good work.

(Thanks Rusty, but there's so much more that needs to be done that I need a clone — Wayne)

Jerry Richter K1IWY. Oh Uncle Wayne, you sly old devil, you. How did you ever come to possess the uncanny ability to become a Monday morning quarterback the day before the game in all matters of the world, including your analysis of our fine government? As I listen to the strains of "The Star Strangled Blander," I salute you. Your May editorial relating to "Work Ethic" and "Management" was right on. Ooooh! Made me feel gooood! Being a federal gov't/Navy retiree, I could relate to both areas and on both sides of the coin. 38 years Naval Reserve and 32 years in the federal government. Amazing, isn't it, how our system operates? I'm really convinced that the government is operated 100% on the Peter Principle. Remember the one where people get promoted to the maximum level of their incompetence and then are transferred to another department and the process starts all over again? Well now, doncha' know we have all these Peters floating atop the workers, who are the real backbone of their organizations, and what happens to the really competent people? You got it. During my 32 years as a government employee I've seen upper management spend entire spring sessions sitting around the office, planning golf tournaments. No, not on their breaks. During work hours. I've witnessed first hand directors telling counselors to drop the sexual harrassment charges filed against supervisors because it would be an embarrassment. You wouldn't believe what the military brass does. Or maybe you would, Uncle Wayne. Our tax payers would rally on the White House steps if they knew what went on with their tax dollars. Like a full bird colonel spending $3,000 of taxpayers money to plant flowers because a three-star is coming, but then doesn't provide for watering, so they all die later. How about the GS-14 that was caught several times flagrante delicto with an office sweetie. Was he punished? No, he was transferred with no loss in pay and the people who turned him in were punished. Ooops, I forgot, this is a ham radio magazine. Great publication! Keep it up please. See what your editorials do to people?

Jerry, you really should write a book! When I found out what was going on that most people don't know about. I wrote one... Wayne.

See Green Team help wanted ad bottom of page 83, November 1995, 73 Magazine

BARTER 'N' BUY

Continued from page 71